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COMMAND WASHINGTON DC CHESAPEAKE.. MAY 85

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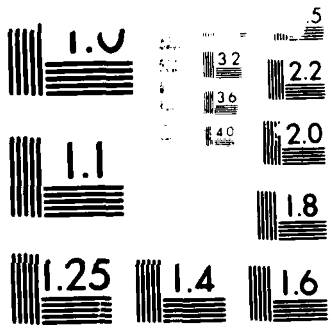
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BARSTUR UQC REPAIR/REPLACEMENT CABLE INSTALLATION PROJECT EXECUTION PLAN

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MAY 1985

OCEAN ENGINEERING
AND CONSTRUCTION PROJECT OFFICE
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D.C. 20374

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The Chesapeake Division, Naval Facilities Engineering Command (CHESNAVFAC-ENGCOM) and The Naval Underwater Construction Team Two have been tasked by Naval Air Systems Command (NAVAIR) to repair three UQC cables of the Barking Sands Tactical Underwater Range (BARSTUR) Systems at the Pacific (Con't)

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Missile Range Facility (PMRF) Barking Sands, Kauai, Hawaii. To effect the repair, three sea/shore interface cables will be replaced by three UQC repair/replacement cables installed from the cable termination hut on shore out to approximately 0.8 nautical miles (nmi) offshore. The construction operations will be completed by July 1985.

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Abstract

The Chesapeake Division, Naval Facilities Engineering Command (CHESNAVFACENGCOM) and The Naval Underwater Construction Team Two have been tasked by Naval Air Systems Command (NAVAIR) to repair three UQC cables of the Barking Sands Tactical Underwater Range (BARSTUR) System at the Pacific Missile Range Facility (PMRF) Barking Sands, Kauai, Hawaii. To effect the repair, three sea/shore interface cables will be replaced by three UQC repair/replacement cables installed from the cable termination hut on shore out to approximately 0.8 nautical miles (nmi) offshore. The construction operation will be completed by July 1985.

I. PROJECT DESCRIPTION

BACKGROUND

Three UQC cables are essential components of the BARSTUR (Figure 1) providing two-way communications capability between the offshore range and the tracking control operations facility on shore. During the past few years, the cables associated with the UQC system have sustained damage that has downgraded the tracking capabilities of the system and thereby limited range operations.

The UQC Repair/Replacement Cable Installation Project will replace the three UQC cables and restore the range to its full capability.

SCOPE OF WORK

Three UQC sea/shore interface cable sections of the BARSTUR at PMRF, Kauai, Hawaii will be replaced by 1 July 1985. The three cables are to be installed from an existing cable termination hut on shore to an offshore position where the existing cables are undamaged. At the offshore position the replacement cables will be spliced to the existing cables. Upon completion of the installation, each cable will be tested and stablized in accordance with Appendix E. Excavation of a trench adjacent to the existing cables from the concrete groin to the cable termination hut, cable splicing, and restoration of the beach site are to be accomplished in accordance with Appendices G.

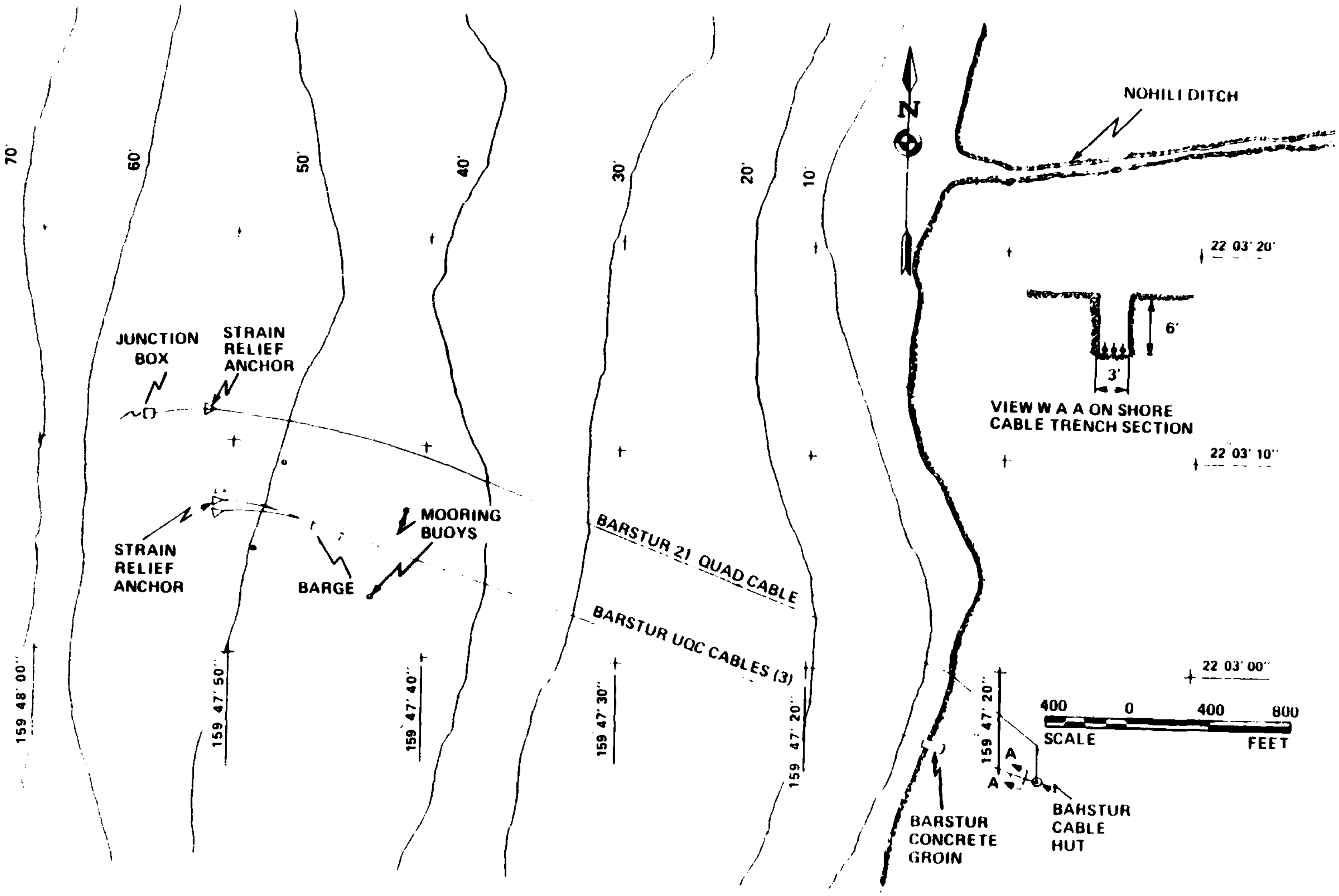


Figure 1. BARSTUR UQC Cable Repair 4 Point Moor and Inshore Cable Layout

II. TASKING, RESPONSIBILITIES AND INTERFACE

PROJECT TASKING

Chesapeake Division Naval Facility Engineering Command (CHESNAVFACENGCOM) was assigned by NAVAIR to execute the UQC repair/replacement cable installation at BARSTUR PMRF, Kauai, Hawaii. UCT-2, Port Hueneme, California was tasked by CHESNAVFACENGCOM as the construction agent.

CHESNAVFACENGCOM was assigned responsibility for project execution and for providing logistics, planning and engineering support to UCT-2. Organizational responsibilities for the execution of project functions are outlined in the work breakdown structure Section III. Naval Electronics Systems Command (NAVELEXSYSCOM) will provide the replacement cables by separate tasking. The cables will be delivered by barge to PMRF Kauai, Hawaii for installation.

CHESNAVFACENGCOM requested Commander Naval Logistics Command, Pacific (COMNAVLOGPAC) and Naval Station (NAVSTA), Pearl Harbor for a YC barge and tug from Navy assets located at Pearl Harbor, Hawaii. The availability of a YC barge was confirmed, with tug service restricted to the Pearl Harbor area. In order to ensure a tug is available for towing service for the YC barge from Pearl Harbor to Kauai, and support throughout the project, assistance was requested for contracting a commercial tug by Military Sealift Command, Honolulu, Hawaii. The tug will be used to tow the barge from Pearl Harbor to Kauai, Hawaii provide towing service as required during the cable installations operation, and return the barge to Pearl Harbor.

CHESNAVFACENGCOM requested cable splicers, splicing equipment and material from NAVELEXSYSCOM to perform three type SB cable splices, on the barge, at sea. CHESNAVFACENGCOM requested support from NSC Pearl Harbor, Hawaii to provide stevedore support for loading cables onto a barge in Pearl Harbor, and assistance in preparing the barge to load cable and project equipment and material.

III. WORK BREAKDOWN STRUCTURE

GRAPHIC DISPLAYS

A Work Breakdown Structure is provided in Figure 2, to describe the various functions required for the execution of the UQC repair/replacement cable installation and stabilization. The following section contains a more detailed writeup of those selected functions required for classification of the project execution process. The Work Breakdown Structure, Figure 2, shows the overall pattern of the effort required for the execution of the UQC Repair/Replacement Cable Installation Project.

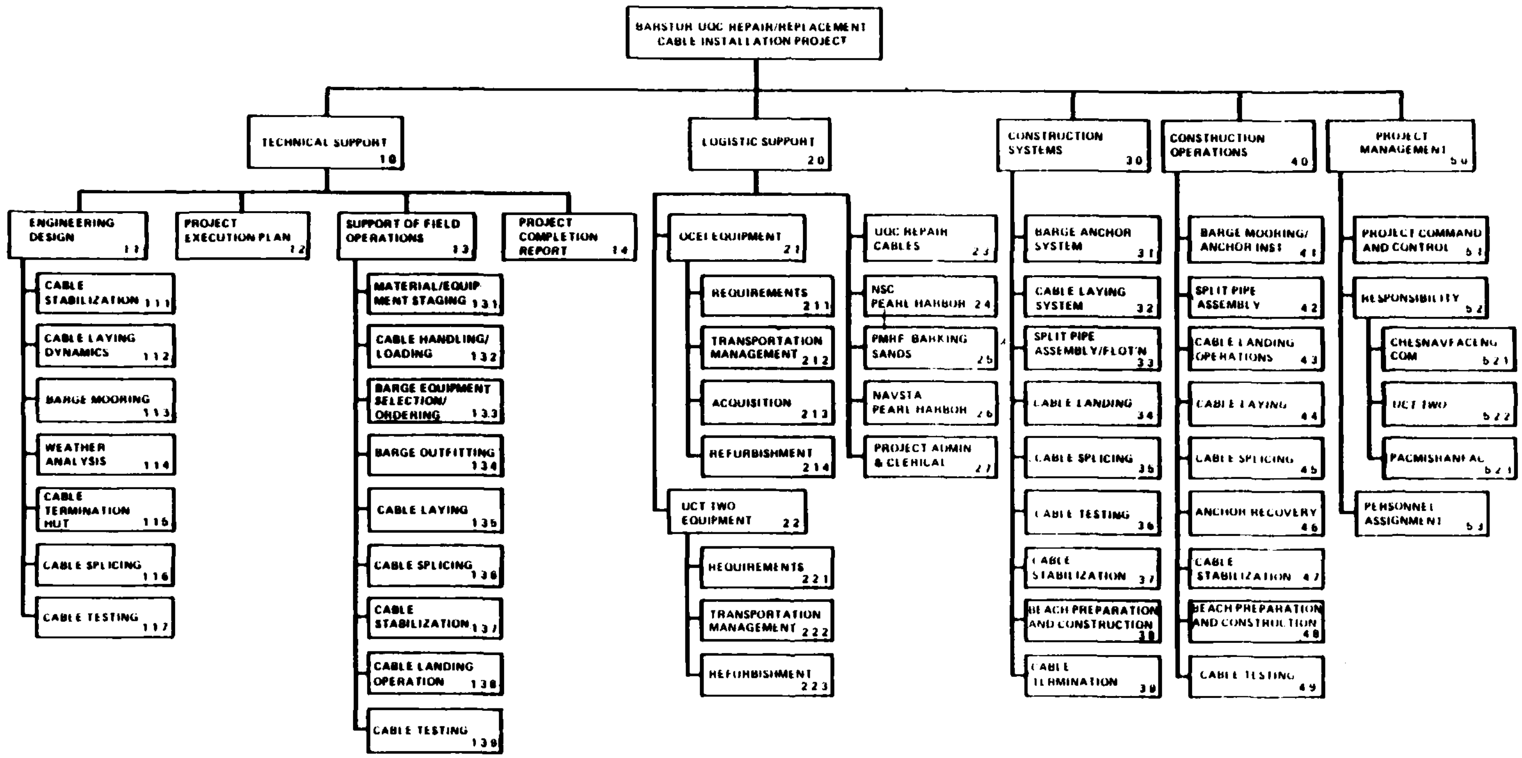


Figure 2. Work Breakdown Structure

1.0 TECHNICAL SUPPORT

1.1 ENGINEERING DESIGN

1.1.1 Cable Stabilization
Responsibility - CHESNAVFACENGCOM FPO-1; **Execution** - CHESNAVFACENGCOM FPO-1 Engineering Division; **Task** - Perform wave analyses, calculate wave drag forces, and recommend cable stabilization distribution.

1.1.2 Cable Laying Dynamics
Responsibility - CHESNAVFACENGCOM FPO-1; **Execution** - CHESNAVFACENGCOM FPO-1 Engineering Division; **Task** - Analyze cable pull and cable laying dynamics to ascertain cable holdback forces for anticipated tension conditions applied to the cable.

1.1.3 Barge Mooring
Responsibility - CHESNAVFACENGCOM FPO-1; **Execution** - CHESNAVFACENGCOM FPO-1 Engineering Division Cable Project Team; **Task** - Establish expected anticipated environmental forces acting on cable barge, select barge mooring hardware, and establish maximum anticipated environmental condition which mooring system will function without failure.

1.1.4 Weather Analysis
Responsibility - CHESNAVFACENGCOM FPO-1; **Execution** - CHESNAVFACENGOM FPO-1 Engineering Division; **Task** - Prepare environmental and weather scenario for project site during the execution period.

1.1.5 Cable Termination Hut
Responsibility - PMTC/PMRF; **Execution** - PMTC/PMRF; **Task** - Provide electrical drawings for the cable termination design specifications and materials for construction.

1.1.6 Cable Splicing
Responsibility - CHESNAVFACENGCOM FPO-1; **Execution** - CHESNAVFACENGCOM FPO-1 Project Engineer, CHESNAVFACENGCOM FPO-1; **Task** - Prepare contract for splicers and cable splicing procedures including equipment and material requirements in order to execute a minimum of three type SB cable splices and three cable terminations.

1.1.7 Cable Testing
Responsibility - PMTC/PMRF; **Execution** - PMTC/PMRF; **Task** - Prepare cable test procedures and equipment material requirements in order to test each UQC repair/replacement cable before and after splicing to projector during the installation operation.

1.2 PROJECT EXECUTION PLAN

(No additional detail to be provided.)

1.3 SUPPORT OF FIELD OPERATIONS

1.3.1 Material/Equipment Staging

Responsibility - UCT-2/CHESNAVFACENGCOM FPO-1 Project Engineer: **Execution** - UCT-2/CHESNAVFACENGCOM FPO-1; **Task** - All equipment and material to support the project will be shipped to NSC Pearl Harbor or directly to PMRF Kauai, Hawaii. Equipment shipped to Pearl Harbor will be loaded onboard the YC cable barge for use in the cable laying effort. This task involves supervising and directing materials and equipment movements to ensure timely arrival and shipment to the YC barge and PMRF.

1.3.2 Cable Handling/Loading

Responsibility - CHESNAVFACENGCOM FPO-1; **Execution** - NSC Pearl Harbor/CHESNAVFACENGCOM FPO-1 Project Engineer; **Task** - Provide supervision and personnel support to execute transfer of cable from transport ship to YC barge.

1.3.3 Barge Equipment Selection/Ordering

Responsibility - CHESNAVFACENGCOM FPO-1 Project Engineer: **Execution** - CHESNAVFACENGCOM FPO-1 Project Engineer; **Task** - Identify and acquire all equipment and material components required to outfit the barge for mooring and cable installation. Order the delivery of all local equipment required for the project.

1.3.4 Barge Outfitting

Responsibility - CHESNAVFACENGCOM FPO-1; **Execution** - CHESNAVFACENGCOM FPO-1 Project Engineer/NSC Pearl Harbor/UCT-2; **Task** - Provide supervision, personnel support, and contractual services to effect the YC barge outfitting for cable operations.

1.3.5 Cable Laying

Responsibility - CHESNAVFACENGCOM FPO-1; **Execution** - CHESNAVFACENGCOM FPO-1 Project Engineer; **Task** - Provide required technical direction to the cable laying operation of the UQC repair/replacement cables.

1.3.6 Cable Splicing

Responsibility - CHESNAVFACENGCOM FPO-1; **Execution** - Contract Splicers (Simplex); **Task** - Provide necessary personnel, material and equipment to perform three SB type splices and three terminations of the SB type cable.

1.3.7 Cable Stabilization

Responsibility - UCT-2; **Execution** - UCT-2; **Task** - Provide technical direction and personnel required to apply split pipe to cable onboard the cable barge and split pipe on the cable where necessary onshore. Provide technical direction and personnel to stabilize the three cables in accordance with Appendix E.

1.3.8 Cable Landing Operation

Responsibility - UCT-2; **Execution** - UCT-2; **Task** - Provide necessary personnel to prepare beach site for cable landing operation including removing the berm, and excavating the trench for three cables from the shore end of the concrete groin to the cable termination point. Provide personnel to execute the cable installation operation to haul cables from the barge to the beach and termination point on shore. Place cables in position in the trench as required and restore the beach and berm to its original profile.

1.3.9 Cable Testing
Responsibility - PMTC/PMRF: **Execution** - PMTC/PMRF: **Task** - Provide all required equipment, personnel and procedures to conduct all necessary tests on the cable just before and after cable splicing.

1.4 PROJECT COMPLETION REPORT
(No additional details to be provided.)

2.0 LOGISTIC SUPPORT

2.1 CHESNAVFACENGCOM OCEAN CONSTRUCTION EQUIPMENT INVENTORY

2.1.1 Requirements
Responsibility - CHESNAVFACENGCOM - FPO-1; **Execution** - CHESNAVFAC-ENGCOM FPO-1 Project Engineer/Project Manager; **Task** - Identify OCEI equipment and material required for use in the UQC repair/replacement cable operation and coordinate their delivery and acquisition to meet project schedules. OCEI assets to be used in the cable repair operation are listed in Appendix B.

2.1.2 Transportation
Responsibility - CHESNAVFACENGCOM FPO-1 Project Engineer; **Execution** -OCEI Manager St. Juliens Creek Annex, OCEI Facility; **Task** - Using requirements identified by the Project Engineer/Manager. Remove the equipment and material required for the project execution from OCEI storage and deliver in accordance with project schedules.

2.1.3 Acquisition
Responsibility - CHESNAVFACENGCOM FPO-1; **Execution** - CHESNAVFAC-ENGCOM Project Engineer/UCT-2; **Task** - Procure those equipment assets which are required for execution of the project.

2.1.4 Refurbishment
Responsibility - CHESNAVFACENGCOM FPO-1; **Execution** - OCEI Manager St. Juliens Creek Annex OCEI Facility; **Task** - Take necessary action to refurbish and restore to working condition all OCEI assets to be provided for the UQC Repair/Replacement Cable Installation Project. Funds for this action will be provided from project funds. Transportation and storage costs for return of equipment will be funded under project TAC number N849.

2.2 UCT-2 EQUIPMENT/MATERIAL

2.2.1 Requirements
Responsibility - Officer-in-Charge (OIC) UCT-2; **Execution** - UCT-2; **Task** - Based on scope of project, identify those UCT-2/Naval Construction Forces (NCF) equipments/material required for project execution. Coordinate the delivery of these equipments to meet project schedules. UCT-2 assets to be used on the project are listed in Appendix B.

2.2.2 Transportation Management
Responsibility - OIC UCT-2; **Execution** - UCT-2/CBC Port Hueneme, California; **Task** - Prepare for transportation and coordinate the movement and delivery of the UCT-2/NCF equipment and material required for the project execution.

2.2.3 Refurbishment

Responsibility - UCT-2: **Execution** - UCT-2/CBC Port Hueneme, California; **Task**- Initiate necessary action to repair, refurbish and restore to an as-issued condition (normal wear-and-tear expected) UCT-2/NCF equipment used during the project execution. Return transportation and storage to be funded under the project TAC number.

2.3 UQC REPAIR/REPLACEMENT CABLES (THREE)

Responsibility- CHESNAVFACENGCOM FPO-1 Project Engineer; **Execution** - CHESNAVFACENGCOM FPO-1 Project Engineer; **Task** - Provide three 0.800 nmi lengths of combined SB type "A" and SB type "AH" cable for delivery at Pearl Harbor, Hawaii no later than 1 June 1985. Task involves all action required for procurement and delivery of cable to marshalling point at Pearl Harbor, Hawaii.

2.4 NSC PEARL HARBOR, HAWAII

Responsibility - NSC Pearl Harbor, Hawaii; **Execution** - OIC Naval Cargo Handling Operations, NSC Pearl Harbor, Hawaii; **Task** - Provide support for cable handling and loading. Provide necessary services for staging project material and equipment. Also provide support to effect mobilization and loading all project materials and equipment onboard barge. Provide support to effect barge demobilization and return of all project equipment to CONUS upon completion of the project.

2.5 PMRF BARKING SANDS KAUAI, HAWAII

Responsibility - PMRF; **Execution** - PMRF Barking Sands; **Task** - Provide following logistic support services during execution of UQC Repair/Replacement Cable Installation Project: berthing and messing for UCT-2 personnel, fuel and maintenance assistance as required for vehicles and equipment used on the project, naval message and telephone communications support, supply and acquisition support to provide for unforeseen spare parts and material requirements; and use of Port Allen Pier Support Services to include pier space for YC barge and intermittent crane service during periods now estimated as 14-16 June and 27-30 June 1985.

2.6 U.S. NAVAL STATION, PEARL HARBOR, HAWAII

Responsibility - NAVSTA Pearl Harbor; **Execution** - OIC Habor Operations; **Task** - Provide YC barge for project use. Provide tug for all barge movements at Pearl Harbor during project mobilization and demobilization.

2.7 PROJECT ADMINISTRATIVE, CLERICAL AND FISCAL ACCOUNTING SUPPORT

Responsibility - CHESNAVFACENGCOM FPO-1/CBC Port Hueneme/ UCT-2; **Execution** - CHESNAVFACENGCOM FPO-1/UCT-2; **Task** - Provide required support to assist in preparation of all administrative and fiscal and accounting documentation required for project execution and for proper accounting of expenditure of funds provided for project.

3.0 PROJECT CONSTRUCTION SYSTEMS

3.1 BARGE ANCHOR SYSTEM

3.1.1 Inshore Mooring

Functions - To moor the YC Cable Barge in a four point moor at the inshore position (see figures in Appendix A) for the shore end cable installation. **Design Basis** - The inshore mooring is designed for mooring the barge securely to

withstand a 1 knot current, 20 knot winds and sea state 4. **Design Restrictions** - The holding capacity of the mooring will not hold the barge against cable tensions developed to straighten out the cable catenary.

3.1.2 Offshore Mooring

Function - To moor the YC Cable Barge in the required position with an ability to move laterally approximately 100 feet to meet the cable operation requirements. **Design Restriction** - The holding capacity of the four point mooring will be determined by onsite test and inspections after installation of the propellant embedment anchors. A tug will stand by the barge where safe working water depths permit. The tug will be used to reduce loads on the barge mooring during periods of high cable tension or heavy seas. The barge moorings are described in Appendix A.

3.2 CABLE LAYING

Function - To provide all equipment required to install the cables from the coiled position on the barge to the shore and during the movement of the barge from the inshore mooring position to the offshore mooring position along the prescribed cable track. **Design Basis** - The cable laying equipment was selected for functional simplicity to meet the relative low risk of laying three sea/shore interface cables under minimum tension. To provide higher hold back tension during the cable landing operation and while applying the split pipe, the cable will be physically restrained with a cable stopper. **Configuration** - The cable laying equipment consists of the following components outlined in Appendix A, Figure A2. A four-legged "A" frame structure will be mounted on the barge over the cable coil. From the apex of the "A" frame, a sheave will be suspended to allow the cable to uncoil freely in a upward direction. The cable will pass from the coil through the sheave where it changes direction and is redirected to the after deck of the barge by a deck mounted sheave. **Deck Sheaves** - Two sheaves will be assembled on deck. The first sheave will guide the cable from the "A" frame to the deck and the second sheave will guide the cable into the cable brake. **Cable Brake Assembly** - A hydraulic clutch type, wood lined friction brake will provide reasonable cable control during cable payout at low running tensions and cable hold back as required when the barge is towed along the cable route during the laying operation. **Guide Posts** - Two 6-inch diameter steel pipe posts, 4 feet high, will be welded on the stern of the barge to provide an overboarding guide for the cable.

3.3 SPLIT PIPE ASSEMBLY AND FLOATATION

Configuration - The following equipment will be used to assemble the split pipe cable on the deck of the barge and passing cable to shore.

- Hydraulic Power Unit - to provide power for the underwater tools and cable brake unit;
- Air Compressor - to inflate floatation balloons and power air tuggers:
- Hydraulic Hand Truck - for moving split pipe and heavy equipment on the barge deck;
- Floatation Ballons - for floating cable and cable with split pipe from barge to shore; and
- Zodiac - for recovery of balloons cut away from cable.

3.4 CABLE LANDING OPERATION

Configuration - The following equipment will be used on the beach in landing each of the three UQC repair/replacement cables on shore

- TD-20 dozer;
- 3,000 foot length of 6-inch NYDAC inhaul line;
- Shackles, swivels, deck line fittings to connect the inhaul line to the cable and to the TD-20 dozer on shore; and
- Radios.

3.5 CABLE SPLICING OPERATIONS

Function - The cable splicing equipment will be used to splice the new SB type repair/replacement cable to the existing cable offshore. **Design Basis** - To perform a cable splice between the cables to satisfy the electrical and mechanical requirements of the UQC cable transmission system. **Design Restrictions** - Due to the necessity for field splicing, factory cable splicing specifications will be adjusted to field conditions providing electrical and mechanical requirements of the cable are met.

3.6 CABLE TESTING

Function - Test equipment will be used to determine if cable electrical performance characteristics are met before and after splices have been made on the cable. **Configuration** - A Tektronics Model 1503 Time Domain Reflectometer will be used to determine discontinuities in the cable. Equipment for insulation and conductor resistance will be provided by PMTC/PMRF. Cable testing just before splicing and after splicing will be performed by PMTC/PMRF. CHESNAVFACENGCOM will test cable before loading on the barge.

3.7 CABLE STABILIZATION

Configuration - The following major equipment will be used to stabilize the UQC repair/replacement cables after installation:

- LARC XV,
- LARC V,
- Hydraulic powerpack,
- Underwater hydraulic drill and bits,
- Hand tools for underwater work,
- Drill templates for split pipe clamps and twin bolt clamps,
- Underwater hydraulic wrenches,
- Floatation balloons,

- Lift bags PR#2 (4400 # CAP), PR#4 (3300 # CAP)
- Diver life support equipment.
- Diver air compressors, and
- Miscellaneous diving operational support equipment.

3.8 BEACH PREPARATION AND CONSTRUCTION

Function - The beach preparation and construction equipment will be used to remove the berm to excavate a trench from the shore end of the concrete groin to the cable termination hut onshore to accommodate the three cables, and also make all required surveys to determine cable routes. **Configuration** - The following equipment will be used for beach preparation and construction:

- TD-20 dozer,
- Front end loader,
- Back hoe,
- Forklift,
- Shovels (hand),
- Survey kit,
- *Hydraulic power unit, and*
- Concrete breaker for beach rock.

3.9 CABLE TERMINATION

Configuration - The cable end termination at the cable termination hut will be performed by cable splicers as required by PMTC/PMRF.

4.0 CONSTRUCTION OPERATIONS

The various steps of the Work Breakdown Structure that are involved in the construction operations have been graphically displayed in Figure 2. Details of the actual operational plans are set forth in Section IV of this Project Execution Plan and will not be repeated here.

5.0 PROJECT MANAGEMENT

5.1 PROJECT COMMAND AND CONTROL

The structure of project command and control for the UQC Repair/Replacement Cable Installation Project is graphically described in Figure 3 on the following page.

5.2 PROJECT RESPONSIBILITIES

5.2.1 CHESNAVFACENGCOM FPO-1

- Provide overall project management for installation and stabilization of the shore end UQC repair/replacement cable operation:

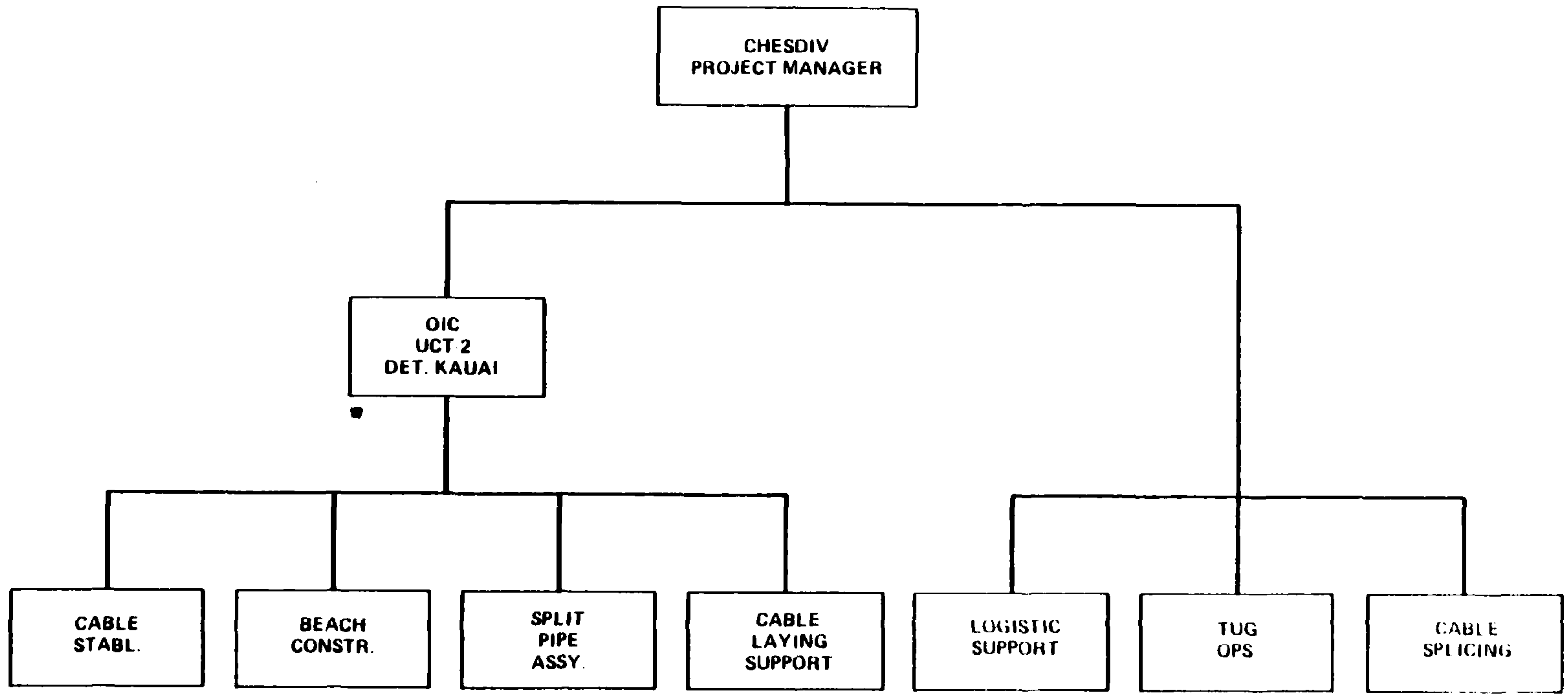


Figure 3. INSTL./OPS. ORGANIZATION

- Provide project logistics, planning and engineering support and coordination for the UQC repair/replacement cable operation;

- Provide personnel and equipment required for loading cable on the barge and cable installation;

- Order/contract tug or barge to support cable laying and cable splicing operation;

- Provide technical support and supervision for all barge outfitting/loading/demobilization;

- Order/contract for all barge outfitting equipment;

- Order/contract for barge outfitting and demobilization;

- Provide split pipe and split pipe fasteners required for project;

- Provide equipment transportation for all CHESNAVFACENGCOM assets used in the project;

- Approve cable test procedures to validate cable splices;

- Provide cable splicing contractor personnel;

- Prepare project execution plan;

- Prepare project completion report including as-built drawings and test results;

- Coordinate with the following activities to provide project services as indicated: COMNAVLOGPAC/NAVSTA Pearl Harbor, Hawaii to provide YC barge for project duration; and provide tug services for barge movement in the Pearl Harbor area;

- NSC Pearl Harbor, Hawaii: Effect cable loading on barge, prepare barge for cable loading, load project material and equipment, assist in barge outfitting and demobilization, receive, store and move material as necessary to service the project; and

- MSC Honolulu, Hawaii: Provide commercial tug services to tow barge from Pearl Harbor to Port Allen, assist barge during cable installation and return barge to Port Allen and Pearl Harbor.

5.2.2 UCT-2

- Provide project OIC.

- Layout, identify and provide all equipments required to pull the UQC repair/replacement cables from barge to shore and to cable termination position. Apply split pipe to cable onboard barge.

- Transport military personnel to job site.

- Provide details for execution of UCT-2 functions for insertion in the project execution plan.

- Review the execution plan.
- Prepare transportation, order repair parts and operate the LARC XV and LARC V.
- Provide all UCT-2 project equipment and equipment provided by NCF for project for shipment.
- Provide personnel to perform site survey as required.
- Provide personnel to operate all beach equipment and barge equipment.
- Provide assistance to cable splicers as required during the splicing operation.
- Prepare and promulgate project operations order via military chain-of-command.
- Provide maintenance of UCT equipment on job site.
- Provide logistic support personnel at Pearl Harbor and Kauai, Hawaii.
- Provide diving support for project execution.
- Provide UCT-2 communication assets.
- Assist CHESNAVFACENGCOM in acquisition of project material.

5.2.3 PMTC/Pacific Missile Range Facilities Barking Sands, Kauai, Hawaii

- Coordinate UQC Repair/Replacement Cable Installation:
- Approve cable stabilization design;
- Provide material support as listed in Appendix B;
- Provide cable end termination design;
- Coordinate and execute cable test procedures;
- Coordinate and provide berthing and maintenance assistance as required for barge, project vehicles, and equipment; naval message and telephone communication support, and supply acquisition support to provide for unforeseen spare parts and material requirements; vehicles requested by UCT-2, use of Port Allen pier services including pier space for YC barge and intermittent crane services estimated to be 14-16 and 23-25 June 1985; and assistance in locating cable in the beach area during beach excavation operations.

5.3 PERSONNEL ASSIGNMENTS

Project personnel assignments are shown in Appendix D. Project execution responsibilities are as follows:

- CHESNAVFACENGCOM Project Manager/Engineer. Provides overall project direction. Provides technical assistance and consultation to UCT-2 in executing construction operation. Provides coordination of project execution

activities with PMRF personnel. Responsible for YC barge outfitting, movement, mooring and utilization during the UQC repair/replacement operation responsible for execution of all project activities onboard the YC barge. Controls all tug movements associated with handling, towing and mooring the YC barge. Responsible for all cable landing and laying. Coordinates the activities of contract splicers.

- OIC UCT-2 DET KAUAI - Project Construction Agent. Responsible for executing all field construction activities required for project execution. Senior officer present is the diving officer.
- OIC UCT-2 DET KAUAI - Diving Supervisor. Responsible for supervising all military enlisted personnel assigned to the UQC Repair/Replacement Cable Installation Project. Also responsible for supervising all project diving activities.
- Project Support Coordinator, PMTC/PMRF, Barking Sands. Responsible for coordinating project execution support requirements with PMRF as requested by OIC UCT-2.
- Project Cable Test Engineer, PMTC/PMRF Cable Test Engineer. Responsible for performing cable testing during the cable splicing evolution.

IV. CONSTRUCTION OPERATIONS PLAN

1.0 OPERATIONAL PROCEDURES OVERVIEW

This procedure assumes the new UQC repair/replacement cable will be laid adjacent to the existing cables. The existing cables will not be recovered, however, at the point of interception approximately 0.800 nmi offshore; the existing cable will be recovered for splicing to the new UQC repair/replacement cable. The proposed route of each cable from the termination point onshore to the offshore splice position as shown in Figure 1. Each cable is identical in type and length; however they are identified as No. 1, No. 2 and No. 3 with No. 1 being the southern most cable. Each cable will be located with the cable locator probe and marked with a buoy for identification for splicing. The cables will be laid along the prescribed track to the proposed splice position offshore. Although the plan relates only to the installation of these cables, the drawings indicate the location of other existing cables which are in close proximity to the UQC repair/replacement cable installation, in particular the 21 quad cable is shown.

The three UQC repair/replacement cables contain the following characteristics:

Type	O.D.	LENGTH	WEIGHT	
			TONS	POUNDS
SBAH	2.4 in	0.300	4.155	9,310
SBA	1.83 in	0.500	5.570	12,378

Each cable is in one continuous length with the different types joined by a factory splice or transition. The sea end of each cable will be spliced to the existing cables approximately 0.800nmi offshore. The beach end of the cables will be terminated in the cable termination hut. Each cable will be anchored to the existing beach anchor. A YC barge will be provided by the NAVSTA, Pearl Harbor, Operations Department/Port Services. The barge will be outfitted with an "A" frame and equipment for the UQC cable operation. The cables will be loaded on the barge together with split pipe, generator, hydraulic power unit, portable winches, sheaves and other ancillary equipment necessary for the UQC cable operation.

1.1 CABLE INSTALLATION

The plan specifies procedures for the installation of three repair/replacement cable sections to replace three existing cable sections at Pacific Missile Range Facility BARSTUR System including the stabilization and protection of the cables with split pipe and rock bolts as outlined in Appendix E. The cable will be supplied by NAVELEX from Navy Stock Cable located at Simplex Wire and Cable Plant Portsmouth, New Hampshire. The cable will be transported by truck from Portsmouth, New Hampshire to Oakland, California and then by sea to Pearl Harbor, Hawaii. At Pearl Harbor the cable will be offloaded from the transport vessel and transfered to the YC barge. After the cable and all equipment has been loaded onto the barge, at Pearl Harbor, the barge will be towed to Port Allen, Kauai, Hawaii.

1.2 BARGE MOORING

The offshore mooring consisting of four embedment anchors, moorings and buoys will be installed in advance of the project operation. The position of the mooring is planned to be approximately 5000 feet offshore convenient for mooring the barge over the existing UQC cable. The specific offshore mooring location will be determined during the initial offshore survey. The offshore mooring system is designed to hold the barge in position during the cable recovery operation, cable splicing, and placing the cable in sea water splicing operations. Four concrete clump anchors and their moorings will be placed approximately 1,000 feet offshore to moor the barge in position for the cable landing operation. The barge will be assisted in position by the LARCs and tug during the mooring and unmooring operation. The tug will be retained in a standby status offshore, after the barge is safely moored in position. The barge towing hawser will be retained onboard the barge and available for immediate attachment to the tug throughout the cable operations.
The inshore barge mooring is designed to hold the barge in position for the cable landing operation. Split pipe is applied to the cable as it is passed to shore. A survey of surf conditions on site, water, depth and length of cable to shore are factors used in selecting the inshore mooring position. The location can only be used in fair weather and moderate seas.

The barge anchors have been selected to accomodate the expected 1 knot tidal current, 20 knot northwest winds and 4 feet 4 second period waves. Figure 4 shows a diagram of the barge inshore mooring configuration. Details of the mooring system analysis is contained in Appendix A. If the tidal current begins to deflect the cable after the cable end is passed to shore, the TD 20 tractor will be used to remove the catenary. Based on the described sea conditions above, the cable tensions may result in dragging of the anchor clump. To offset this, the tug will be on hand to take a strain on the towing bridle until the cable is landed, the catenary in the cable is removed, and all float balloons are removed from the cable and the cable is allowed to submerge to the seabed. Additional analysis of this condition are contained in Appendix A.

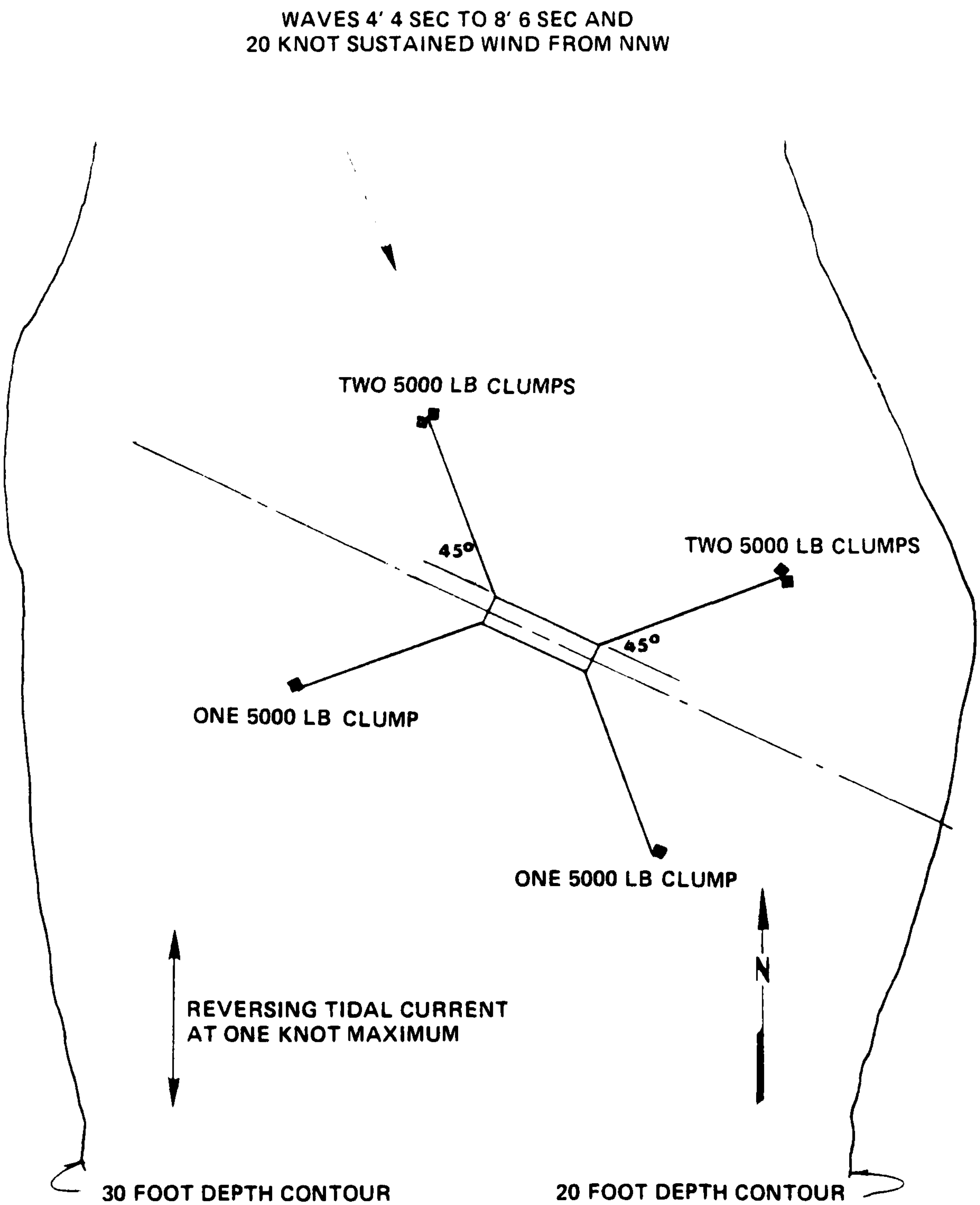


Figure 4. BARSTUR Barge Inshore Mooring Force Diagram

1.3 CABLE LANDING OPERATIONS

Subsequent to the barge arriving at the inshore mooring and being moored in position, the No. 1 UQC repair/replacement cable will be prepared for landing. One end of the 3,000 foot NYDAC hauling line will be passed from the barge to the LARC V which will haul the end to shore. On shore the hauling line will be attached to the dozer in preparation for hauling. Onboard the barge the hauling line will be married to the cable. When the beach and barge preparations are complete, the cable hauling operation will commence. Approximately 650 feet of cable will be paid out toward shore with floatation balloons attached at intervals of 15 to 20 feet. The balloons will provide the necessary floatation to keep the cable afloat until it reaches shore. When the 650 feet of cable has been paid out, the dozer will cease hauling and the cable will be secured on the barge, to allow split pipe to be applied to the cable on the barge. The split pipe will be attached to the cable in spans of 36 feet (12 sections) as each span is applied it will be paid out, until 250 feet of split pipe has been applied to the cable and has left the barge. Floatation balloons will be attached to the split pipe and cable (two balloons to a 3-foot pipe section). When the cable reaches the seaside of the concrete groin it will be passed throught the conduits of the groin if sand levels permit. If the conduits cannot be penetrated the cables will be passed to the south of the groin and encased in concrete. Cable payout will continue from the barge with the tractor hauling the cable to shore until the required length of cable is on shore.

1.4 SPLIT PIPE APPLICATION

It is anticipated that the split pipe can be applied to the cable on the deck of the barge in intervals of 36 feet (12 sections of 3 feet). The cable and split pipe will be paid out after each 36-foot section is completed. During the process of paying out the 300 feet of split pipe, special attention will be exercised to secure balloon floats correctly at the required spacing of two per 3 feet section of split pipe. Spacing of the balloons on the cable only will be every 15 feet. When the split pipe encased cable is removed from the barge and is afloat, every effort will be made to expedite the pull to shore.

1.5 CABLE LAYING

The cable hauling process, to the beach will continue until the cable end reaches the concrete groin. At this point the hauling line well be separated from the cable as necessary. The diver/swimmer team will cut the floatation balloons free from the cable and connect the cable end to the messenger line extending from the conduit. The cable hauling process will continue with the primary hauling line married to the cable being pulled directly to the beach and the secondary hauling line attached to the cable end being pulled through the conduit. The twin hauling procedure will be performed simultaneously with the diver/swimmer team assisting the cable end through the conduit. The floatation balloons will be cut free of the cable to proceed through the conduit unfettered. The hauling process will continue until the split pipe encased cable arrives at the conduit. At this point the diver/swimmer team will attach the split pipe, or coupling to the existing split pipe conduit at the concrete groin. The cable end should now be located at the termination point on shore. After the split pipe is attached the primary hauling line and floatation balloons will be cut free from the cable, allowing the cable to settle to the sea bed. After the cable has been cleared of all balloon floats and secured onshore the barge, the barge will be prepared for cable laying. The barge will take on the towing line from the tug and break from the mooring. When the lines are recovered and clear, the tug will proceed to tow the barge along the prescribed cable track. The barge will pay out cable

enroute until it arrives at the offshore mooring. As the tug and barge approaches the offshore mooring position, the cable lay out speed will be slowed down to enable the LARCs to assist in the mooring line handling to the buoys. After the barge is safely secured in the mooring, the cable will be secured and prepared for the splicing operation. The location of the barge in the four point moor and splice position will be determined during the diver survey conducted prior to the four point moor installation.

1.6 CABLE SPLICING

The existing No. 1 UQC cable will be cut on the seabed by the divers at a predetermined position. The shore end of the cut cable will be sealed and left undisturbed on the seabed for future use. The sea end of the cable will be recovered from the seabed, lifted onto the barge and tested in preparation for splicing. The shore end of the repair/replacement cable will also be tested before the splicing operation. After the splice is completed, the cable will be tested to verify its electrical integrity. The cable will then be prepared for overboarding. During the overboarding process careful attention will be required to ensure that the cable and splice adhere to a straight line configuration. Divers will inspect the cable on the seabed and move it if necessary with the assistance of lift bags. With the completion of the installation of the No. 1 UQC repair/replacement cable, the barge will return to the inshore moor and prepare for the next cable installation. The No. 2 UQC repair/replacement cable and No. 3 UQC repair/replacement cable will follow the same procedures as described for the No. 1 UQC repair/replacement cable. Since the three cables are identical, the spacing and separation of the cables after they are laid will be the only means of identification. The position of the barge in each mooring location will be adjusted to provide the necessary separation. During the cable laying operation each cable will be critically observed to prevent any possible cross over and maintain the required separation. A minimum separation of 60 feet is planned between cables in the offshore mooring position.

With the completion of the third cable installation the barge and tug will return to Port Allen for demobilization and preparation for tow to Pearl Harbor, Hawaii. All equipment not required for the cable stabilization operation will be loaded onboard the barge for transfer to Pearl Harbor, Hawaii.

The termination of each cable on shore will be made by the splicing team as each cable laying operation is completed. The cable terminations will be conducted under the guidance of the PMRF Electrical Supervisor.

2.0 CONSTRUCTION OPERATIONS - WORK BREAKDOWN STRUCTURE

2.1 FOUR POINT MOORS, BARGE MOORING INSTALLATION

2.1.1 Anchor Location Survey

The position of each anchor for mooring the barge will be established by a survey including a diver conducted cable search survey.

2.1.2 Anchor Installation

The offshore mooring will consist of four 20 KIP embedment anchors. Each anchor will be placed in a predetermined position identified by a small marker buoy. The inshore mooring will consist of concrete clump anchors, wire and chain. Six 5000-pound concrete clump anchors will be deck-loaded on the cable barge at Pearl Harbor, and positioned for overboarding during the final barge preparations at Port Allen, Kauai, Hawaii. The concrete clump anchors will be rigged for launching from the barge with lift bags attached. As the offshore mooring will be in place prior to the cable operation, the barge will be secured

in the offshore moor for the installation of the inshore anchors. Each clump anchor will be slipped from the barge supported by the lift bag. The anchor will then be towed by the LARC V and dropped in a predetermined position. The lift bag will be released and used for the next anchor. Divers will inspect the mooring pendant and ensure no fouling has occured during the installation. For the anchor positions located at the northwest and northeast of the mooring, two clump anchors will be used. Each concrete clump anchor will be dropped in close proximity for easy attachment.

2.13 Barge Moorings

For cable operations the barge will be towed into close proximity of the inshore mooring assisted by the LARC XV and the LARC V. The LARC V will pass the mooring line from the barge and attach it to the northeast buoy. When the first line is secure the tug will move seaward clear of the mooring operation, however, the tow line to the barge will remain attached to assist in the barge mooring operation if necessary until all four mooring lines are secured. Using the barge winches and air tuggers, the crew will adjust the mooring lines for constant scope and tension for prevailing sea conditions.

- If sea conditions deteriorate and prevent a continuation of cable operations, the barge will be released from the inshore mooring and taken in tow to the offshore mooring.

- During all evolutions the tugs towline will remain attached to the barge. The tug will stand to seaward in readiness to pull the barge to safety.

2.2 SPLIT PIPE ASSEMBLY

The split pipe will be assembled on the cable by UCT-2 personnel. The split pipe will be assembled on the cable while still on the barge in twelve 3-foot sections using hydraulic wrenches and handtools to bolt the half sections of pipe together. A total of 300 feet of pipe will be used on each cable.

2.3 CABLE LANDING OPERATIONS

A 3,000 length of 6-inch NYDAC hauling line will be used for hauling the cable ashore. The landing sequence is as follows:

- Using the LARC V and the Zodiac, a 1-inch light retrieval line will be brought from shore to the barge.

- The retrieval line will be attached to the inhaul line on the barge and pulled ashore by the tractor.

- When the end of the hauling line reaches shore it will be attached to the tractor. The other end will be attached to the cable onboard the barge.

- The cable will then be hauled to shore with the hauling line. As the cable is paid out, floats will be attached to the cable at 15 feet intervals.

- When the prescribed cable length has been paid out the split pipe assembly will commence. As each 12 X 3 foot section of split pipe is attached to the cable it will be paid out to shore. Floats will be attached to the split pipe (two floats to a 3 feet section of pipe). The above sequence will continue until a total of 300 feet of split pipe a protected cable has left the barge.

- The cable hauling operation will continue until the cable end reaches the concrete groin. The twin hauling procedure will commence with the messenger line pulling the cable through the conduit and the primary hauling line pulling the cable to the beach. This procedure will continue until the split pipe is in position.

- When the cable and split pipe have reached their destination, the diving/swimming team will cut away all floatation balloons and allow the cable and split pipe to sink to the seabed.

2.4 CABLE LAYING

The cable laying sequence is as follows:

- After the cable has been landed satisfactorily, the LARC XV and LARC V will assist in casting off the barge mooring lines.

- The tow line to the tug will be checked as each mooring line is slipped from the buoy and recovered on the barge, the tug will then take a slight strain on the tow line.

- When all mooring lines are recovered, the cable will be prepared for pay out.

- The cable will be placed in the cable brake. The brake will be used to maintain a low cable tension as it is paid out.

- The tug will proceed along the prescribed route at a speed determined by the Project Engineer. The LARC XV will be used to keep the barge on track should it be necessary to offset winds and current.

- As the barge reaches the offshore mooring position, the tug will slow down and allow the LARC XV and V to assist with mooring lines to the buoys.

- During the barge mooring operation, the proper cable tension will be maintained to provide a minimum of slack cable.

- Final adjustment on the cable tension and mooring lines will be corrected to accomodate the desired cable splice position.

- When the barge is in position the sea end of the existing cable will be cut by the divers and the end brought onboard the barge. The cables onboard the barge will be secured for the splice operation.

2.5 CABLE SPLICING.

The splice operation between the two cable ends will be performed by the Simplex Splicing Team. under contract to CHESNAVFACENGCOM. Splices will be performed in accordance with Simplex Field Specifications for SB type cables.

2.6 ANCHOR RECOVERY

The embedment anchors used for the offshore mooring will be a permanent installation, however, the pendants will be removed after completion of the project. The inshore clump anchors will be removed by the lift bag method. The anchors will be floated to the barge, lifted by the winch, and secured clear of the water with slings for transit to Port Allen. The clump anchors will be lifted onboard the barge by a crane at Port Allen for return to Pearl Harbor. Hawaii.

2.7 CABLE STABILIZATION

The three UQC repair/replacement cables will be stabilized in accordance with the procedures outlined in Appendix E. The 300 feet of split pipe will be applied onboard the barge as the cable is being installed. All rock bolt drilling operations will subsequently, be performed by UCT-2 divers. Stabilizing the split pipe in the surf zone will be performed during periods of minimal surf action; and offshore stabilizing activities will be conducted as sea conditions dictate. The cable clamps are to be installed as outlined in Appendix E. Diving operations for the stabilization operations will be conducted from the LARC XV and LARC V.

All stabilization will be inspected by UCT-2. Locations of all stabilization points along the cable will be noted and recorded for inclusion in the project completion report.

2.8 BEACH PREPARATION AND CONSTRUCTION

The UCT-2 personnel will travel to the PMRF site during mid May 1985 to unpack, assemble and checkout all equipment. Onsite preparations will include the following:

- Locate the bench marks,
- Survey cable track from the cable termination hut to the concrete groin,
- Survey and mark with bouys the location of each anchor position of the inshore four point moor,
- Survey and mark with bouys the location of each anchor position of the offshore four point moor,
- Locate, survey and mark with buoys the three existing cables at the proposed splice location,
- Remove berm at the beach cable track location,
- Prepare the cable trench across the beach from the groin to the cable termination point if feasible,
- Establish the proposed offshore cable track to be used during cable installations, and
- Prepare all wire mooring pendants for the anchors to buoys.

2.9 CABLE TESTING

Each cable will be tested in accordance with procedures established by PMTC/PMRF as shown in Appendix F. Tests will be conducted on the new cable as follows:

- Before cable is loaded on the barge.
- Immediately prior to installation,
- After each cable has been paid out, prior to splicing operations,
- After each splice has been performed between the new cable and existing cable, and
- After each cable has been terminated in the termination hut.

No tests will be conducted without the approval of the CHESNAVFACENGCOM Project Engineer. Results of all cable tests will be provided to CHESNAVFACENGCOM by PMTC/PMRF for inclusion in the project completion report. Causes of an unsatisfactory test will be resolved at the time of testing. No existing UQC working cable will be cut unless authorized by PMTC/PMRF.

V. EXECUTION SCHEDULE

JOB PRIORITIES

The installation and stabilization of the UQC repair/replacement cables will be accomplished in the following sequence:

1. Install the No. 1 UQC repair/replacement cable with 300 feet of split pipe.
2. Install the No. 2 UQC repair/replacement cable with 300 feet of split pipe.
3. Install the No. 3 UQC repair/replacement cable with 300 feet of split pipe.
4. Stabilize all UQC repair/replacement cables from the concrete groin to the splice location.

The purpose of establishing these priorities is to ensure proper emphasis is given to the completion of each task to accommodate schedule changes due to inclement weather or other unforeseen delays.

PROJECT EXECUTION SEQUENCE

1 March - 15 March

1. Prepare first draft of the execution plan.
2. Identify all OCEI equipment required for project and forward to Port Hueneme, California for transshipment to NSC Pearl Harbor, Hawaii.
3. Order all long lead consumables.

4. Request project support from NSC Pearl Harbor for barge outfitting and cable handling support.

5. Request cable tailoring by Simplex through NAVELEXSYSCOM.

6. Request cable transportation from Simplex to Pearl Harbor. Hawaii.

7. Request NAVSTA Pearl Harbor provide tug and barge support.

8. PMRF provide cable route data from groin to cable termination point.

9. Request information on availability of commercial tug through Military Sealift Command. Honolulu. Hawaii.

16 March - 31 March

1. UCT-2 execute fabrication of cable clamps.

2. UCT-2 review project execution plan.

1 April - 15 April

1. UCT-2 forward first shipment of material to NSC Pearl Harbor. Hawaii.

2. Forward final draft of project execution plan to PMRF/UCT-2 for approval.

3. CHESNAVFACENGCOM ship all material to UCT-2 for surface shipment to NSC Pearl Harbor, Hawaii.

16 April - 30 April

1. UCT-2 forward final shipment of equipment and material from Port Hueneme. California to NSC Pearl Harbor and PMRF. BARSTUR. Kauai. Hawaii.

2. Cable departs Simplex for Pearl Harbor, Hawaii.

1 May - 7 May

1. UCT-2 advance party proceed to Pearl Harbor and PMRF. BARSTUR. Kauai. Hawaii to assist transport of UCT equipment and material.

2. UCT-2/PMRF approve project execution plan.

8 May - 15 May

1. UCT-2 advance party unpack project equipment.

2. CHESNAVFACENGCOM personnel depart Washington for Pearl Harbor. Hawaii.

3. CHESNAVFACENGCOM - UCT-2 - PMRF initiate beach survey and survey of offshore mooring sites.

4. Separate equipment/material shipments at NSC Pearl Harbor for barge outfitting and or shipment to PMRF, Kauai, Hawaii.

16 May - 23 May

1. CHESNAVFACENGCOM assume custody of barge.

2. Commence barge outfittings.

3. Commence beach construction as personnel equipment and schedule permit.

4. Finalize survey for offshore anchor positions.

24 May - 31 May

1. Embedment anchor installation for offshore moor.

2. Main body UCT-2 detachment depart Port Hueneme for PMRF, Kauai, Hawaii.

1 June - 7 June

1. UQC repair/replacement cable arrive NSC Pearl Harbor, Hawaii transfer cable from ship to barge.

2. UCT-2 detachment arrive PMRF, Kauai, Hawaii.

3. Complete barge loadout and operational tests on all onboard equipment.

4. Commence excavation of berm and trench from concrete groin to cable termination hut. Cut trench in rock if practical.

5. Complete planning for cable installation.

6. Complete testing of the offshore mooring with the LARC XV.

7. Prepare barge mooring pendants for inshore and offshore anchors.

8 June - 10 June

1. Complete identification of cable splice locations.

2. Remove all cable stabilization on existing cable in the vicinity of the splice positions in preparation for recovery of cables.

3. Tug and barge depart Pearl Harbor, Hawaii.

11 June - 12 June

1. Tug and barge to arrive Port Allen, Hawaii.

2. Review cable installation and splicing operation plan

3. Assemble all equipment and hardware required onboard the barge for sea operations including anchoring cable installation, splicing and testing.

13 June - 14 June

1. Barge and tug leave Port Allen for cable operations site.
2. Install all anchors and buoys for mooring barge in the inshore and offshore moor. LARCS will assist in the inshore moor installation.

15 June

1. Install No. 1 UQC repair/replacement cable.
2. Commence splicing operation.

16 June

1. Complete splice operation.
2. Test cable.
3. Overboard cable and splice.
4. Diver survey to inspect cable and splice layout.

17 June

1. Install No. 2 UQC repair/replacement cable.
2. Commence splice operation.

18 June

1. Complete splice.
2. Test cable.
3. Overboard cable and splice.
4. Diver survey to inspect cable and splice layout.

19 June

1. Install No. 3 UQC repair/replacement cable.
2. Commence splice operation.

20 June

1. Complete splice.
2. Test cable.
3. Overboard cable and splice.
4. Diver survey to inspect cable and splice layout

21 June

1. Barge move to inshore mooring.

2. Barge recover all inshore mooring hardware from ocean floor.

3. Splicer prepare permanent terminations on all cables at the termination hut.

4. Barge returns to Port Allen, Hawaii.

22 June

1. Offload all equipment required at PMRF and load all equipment not required for project for transit at Pearl Harbor, Hawaii.

23 June

1. Tug and barge depart for Pearl Harbor, Hawaii.

2. Resume work on backfill of trench and berm restoration.

3. Commence stabilization of UQC repair/replacement cables.

25 June

1. Tug and barge arrives Pearl Harbor, Hawaii.

2. Tug is released from project.

3. Commence barge demobilization.

26 June - 1 July

1. Complete barge demobilization.

2. Return barge to NAVSTA.

3. Prepare equipment for return to CONUS.

4. Complete beach and berm restoration.

2 July - 7 July

1. Complete stabilization of UQC repair/replacement cables.

2. Return all equiment to CONUS.

8 July - 29 September

Prepare project completion report on UQC Repair/Replacement Cable Project.

30 September

CHESNAVFACENGCOM forwards project completion report.

VI. TRANSPORTATION AND LOGISTICS

Delivery of the various materials and equipment is considered critical for meeting established schedules. The following summarizes the transportation activities that have already begun and which will continue in order to meet delivery schedules of project material and equipment. All deliveries have been scheduled for arrival at Pearl Harbor, Hawaii not later than 1 June 1985. All equipment transportation costs associated with the project have been charged TAC numbers provided by NAVAIR and CHESNAVFACENGCOM for project use.

PROJECT MATERIAL

The majority of project equipment and materials will be shipped from the OCEI Support Facility, St. Juliens Creek, Norfolk, Virginia and Port Hueneme, California. This includes split pipe and split pipe fasteners, rock bolt anodes and float balloons. All miscellaneous material such as line, wire rope, consumables, etc., to be provided by UCT TWO, will be shipped from Port Hueneme, California. The three UQC repair/replacement cables will be shipped from Simplex Portsmouth, New Hampshire to Pearl Harbor, Hawaii. Transport of the cable to BARSTUR will be onboard the YC barge.

PROJECT EQUIPMENT

All OCEI equipment required for the project and listed in Appendix B are to be shipped from St. Juliens Creek, Norfolk, Virginia to Port Hueneme, California and be turned over to UCT-2 for shipment to Pearl Harbor with the NCF/UCT-2 equipment. Equipment obtained for project use in Pearl Harbor and at Barking Sands will be rented locally through Naval Supply Center Pearl Harbor and the PMRF Contractor at Barking Sands.

PERSONNEL TRANSPORTATION

All project personnel will be moved by government transportation. Requests charge directly to project funds. Transportation will be by commerical air to Honolulu and BARSTUR, Kauai, Hawaii. Local ground transportation will be provided by vehicles assigned to the BARSTUR project or commercial rental cars which are subject to reimbursement by travel claims against project funds.

VII. PROJECT COST ESTIMATE

BACKGROUND

Costs for this project have been developed based on the following assumptions, which if not correct, could result in additional costs.

APPENDIX A
CONSTRUCTION SYSTEMS LAYOUT

BARGE MOORING FORCE CALCULATIONS

Barge to be moored 1000-4000 feet off the beach.

Environmental Conditions:

Tidal Current - Maximum 1 knot, north-south direction (reverses w/tides)

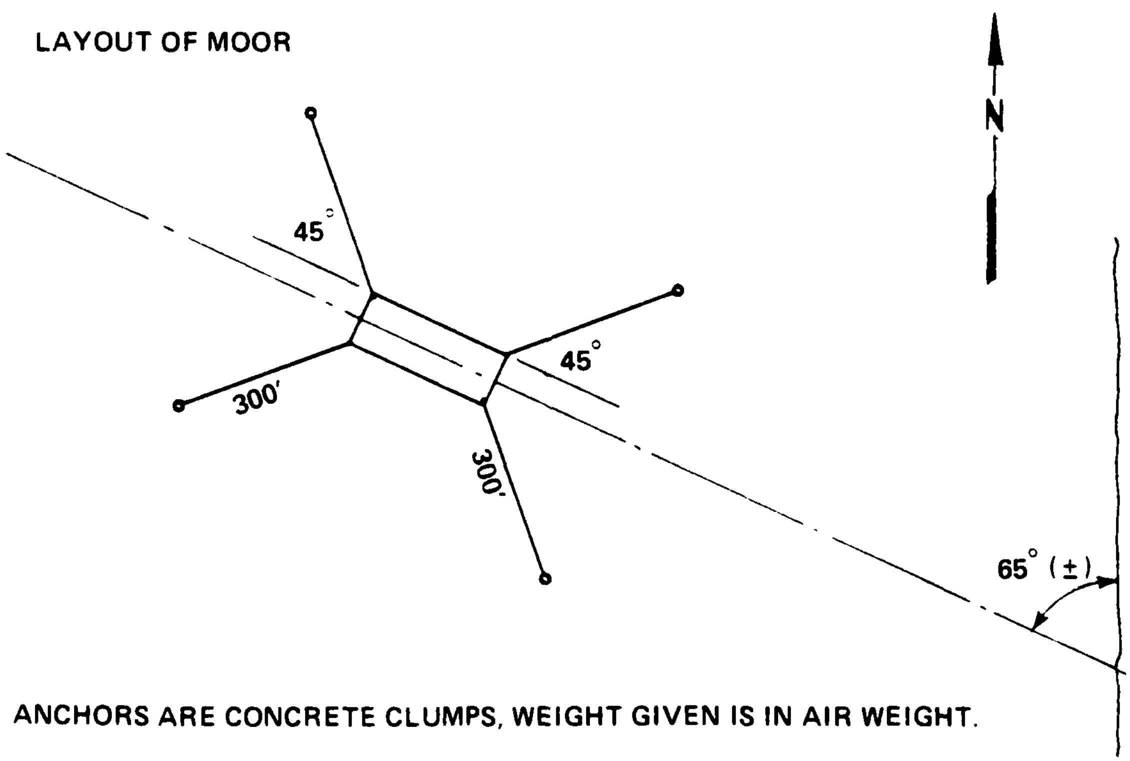
Wind for May - June 20 knot sustained
30 knot gusts
Sustained wind direction NNW-NW
Gusts from NNW to N

Waves - 2-4 feet are about average for working conditions. Above 4 feet is not acceptable for underwater work nearshore. For 4-foot wave, use 4 second period as representative of August. Wave direction generally follows sustained wind, i.e., NNW-NW.

Water Depth - 25-30 feet for 1000-4000 feet off beach.

NOTE: Tasking asked for moor design for Sea State 4 or approximately 8'/6 sec waves. This has been reduced to 4'/4 sec wave because Sea State 4 is too high for working.

LAYOUT OF MOOR



ANCHORS ARE CONCRETE CLUMPS, WEIGHT GIVEN IS IN AIR WEIGHT.

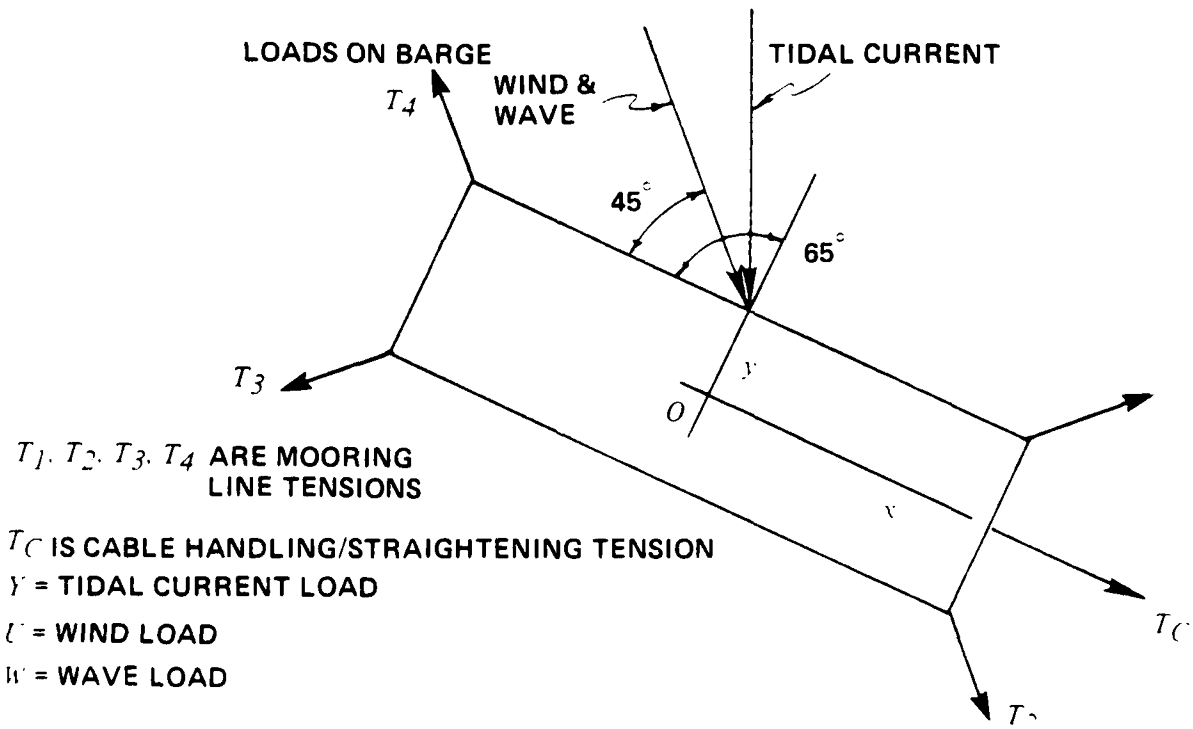
Effective Holding Capacity of 5-ton Concrete Clump

Holding capacity is derived from friction.

$F = \mu N = 0.5\,(10000 \times \frac{86}{150}) = 2867\ lb$ Say 3000 lb.

$\mu = 0.5$ is liberal coefficient of friction for concrete on coral and assumes some degree of wedging into crevices.

Line lengths selected to keep anchors within a 300 foot wide lane centered on the barge-to-beach hauling path. Approximately 500 foot lane exists between existing BARSTUR cables. Shoreward line lengths provide a scope of $\frac{153}{2}\ to\ \frac{153}{20} \approx 6\text{-}7\ 1/2$ which is barge minimum to get effective holding capacity of concrete clump. If existing cables are surveyed and tagged, line lengths could be increased to get better scope.



Loads

For drag load on pipe:

$$F = 1/2\, C_D \rho v^2 D \qquad \text{(lb/ft)}$$

$C_D = 1.2 \qquad \rho = 2 \qquad D = 0.42$ ft (5")

$v = 1$ knot $= 1.69$ ft/sec

$$F = 1/2\,(1.2)(2)(1.69)^2(0.42) = 1.44 \text{ lb/ft}$$

For drag load on balloons:

$$F = F_{Current} + F_{Wind} = 1/2\, C_D \rho_W V_W^2 A_W + 1/2\, C_D \rho_A V_A^2 A_A$$

$V_W = 1$ knot $= 1.69$ ft/sec $\quad V_A = 20$ knots $= 33.78$ ft/sec

Total area of ellipsoidal float balloon =

$\pi ab = \pi(1.3)(0.6) = 2.45 \text{ ft}^2$

(Volume of ellipsoid $= 4/3\, \pi a^2 b = 4/3\, \pi(1.3)^2\,(0.6) = 4.25 \text{ ft}^2$)

(Displacement of ellipsoid = 4.25 x 64 = 272 lb)

Assume 1/2 of area is below water and 1/2 is above.

$$R_{Water} = \frac{(1.69)(2.6)}{10^{-5}} = 4.39 \times 10^{5} \quad C_D\ 0.07$$

$$R_{Air} = \frac{(33.78)(2.6)}{1.6 \times 10^{-4}} = 5.49 \times 10^{5} \quad C_D\ 0.07$$

Note: Used $C_D = 1.2$ for pipe because Reynold's Number $= \frac{1.69(0.42)}{10} =$

$0.71 \times 10 \quad 2.5 \times 10^{5}$

$$F = \frac{0.07}{2}\left[2(1.69)^2(1.22) + (0.00234)(33.78)^2(1.23)\right]$$

$= 0.36$ lb/balloon

Assume 2 balloons/pipe section $= \frac{1000}{3} \times 2 = 667$ balloons

Total Load = 240 lb = 0.24 lb/ft distributed load

$W = 0.24 + 1.44 = 1.68$ lb/ft

By arbitrarily selecting T we can now calculate y from catenary relationships in Mark's Mechanical Engineering Handbook.

T, lb	W/T	Z	$a = \frac{x}{Z}$	Cork Z	$y = a(\text{Cork } Z - 1)$
5000	0.168	0.1704	2934.3	1.01448	42.5 ft
10000	0.084	0.0843	5931.2	1.00354	21.0 ft
15000	0.056	0.0561	8912.7	1.00158	14.1 ft
17500	0.040	0.0480	10416.7	1.00116	12.1 ft
20000	0.042	0.0420	11905.8	1.00089	10.6 ft

For a barge 2000 ft off the beach

$x = 1000'$

= = of balloons = $\frac{2000}{3} \times 2 = 1333$

Total load of balloons = $1333 \times 0.36 = 480$

$= 0.48$ lb/ft

$W = 0.48 + 1.44 = 1.92$ lb/ft

T	W/T	Z	$a = \frac{x}{Z}$	Cork Z	y
5000	0.384	0.4181	2391.8	1.08865	212.0 ft
10000	0.192	0.1957	5109.9	1.01928	98.5 ft
15000	0.128	0.1291	7745.9	1.00958	74.2 ft
17500	0.110	0.1107	9033.4	1.00618	55.8 ft
20000	0.096	0.0905	11049.7	1.00410	45.3 ft

These two tables represent "worst-case" assumptions. The second approach to estimating lateral deflections recognized that only 300 feet of split pipe will be applied to the cable and that lateral loads will be much less than the figures used above. The deflection curve was approximated with a third order equation and maximum lateral displacements were calculated. For a barge 1800 feet off the beach with 300 feet of split pipe and 1500 feet of AA cable, the maximum lateral deflection is about 15 percent less than that calculated for a full 1800 feet of split pipe

Note: More calculations will be made. For now, it appears that a maximum cable tension of 20,000 pounds will be adequate to hold the cable lateral deflections to an acceptable limit. One dozer can provide approximately 20,000 pounds of deadman resistance. About 600-700 HP of the tug will be required to provide 20,000 pounds of thrust to the barge for cable straightening.

For wave and current only $(W = T_C = 0)$, approximate line tension in T_2 (NW'ly anchor) is about 7400 lb. This was calculated assuming T_2 takes 1/2 of the total lateral force and 1/2 of the total longitudinal force.

For three anchors at T_2 available capacity is 9000 lb. giving a nominal factor of safety of 9000/7400 = 1.22.

Thus, the moor appears to be adequate to resist only wave and current loads. The resistance to cable hauling/straightening loads and wave forces must be provided by the tug.

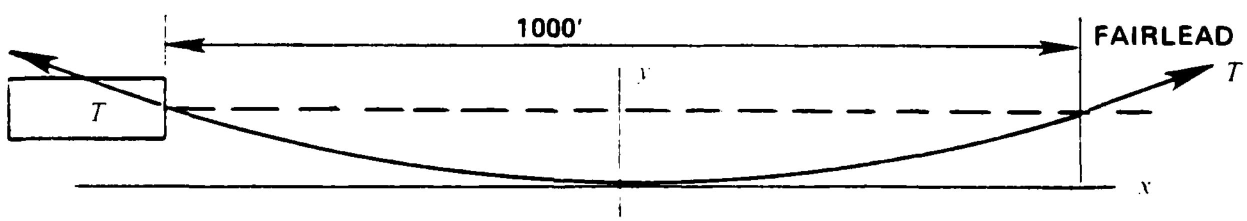
Cable Tension

Two approaches have been taken to estimate lateral displacements vs. cable tension:

Approach 1

Assume that the worst case for lateral displacement would be with the split pipe on the cable for the full distance from shore to barge. This would create the maximum lateral loading since the split pipe has a greater OD than the cable. This should give a greater deflection than 300 feet of split pipe and the remainder bare AA cable.

Assume the barge is 1000 feet off the beach and that the cable passes through a fairlead at the beach. (The fairlead provides the lateral reaction required.)



Then for cantenary calculations, x = 500 feet and y and s (arc length) can be calculated if T and w (load/ft) are known.

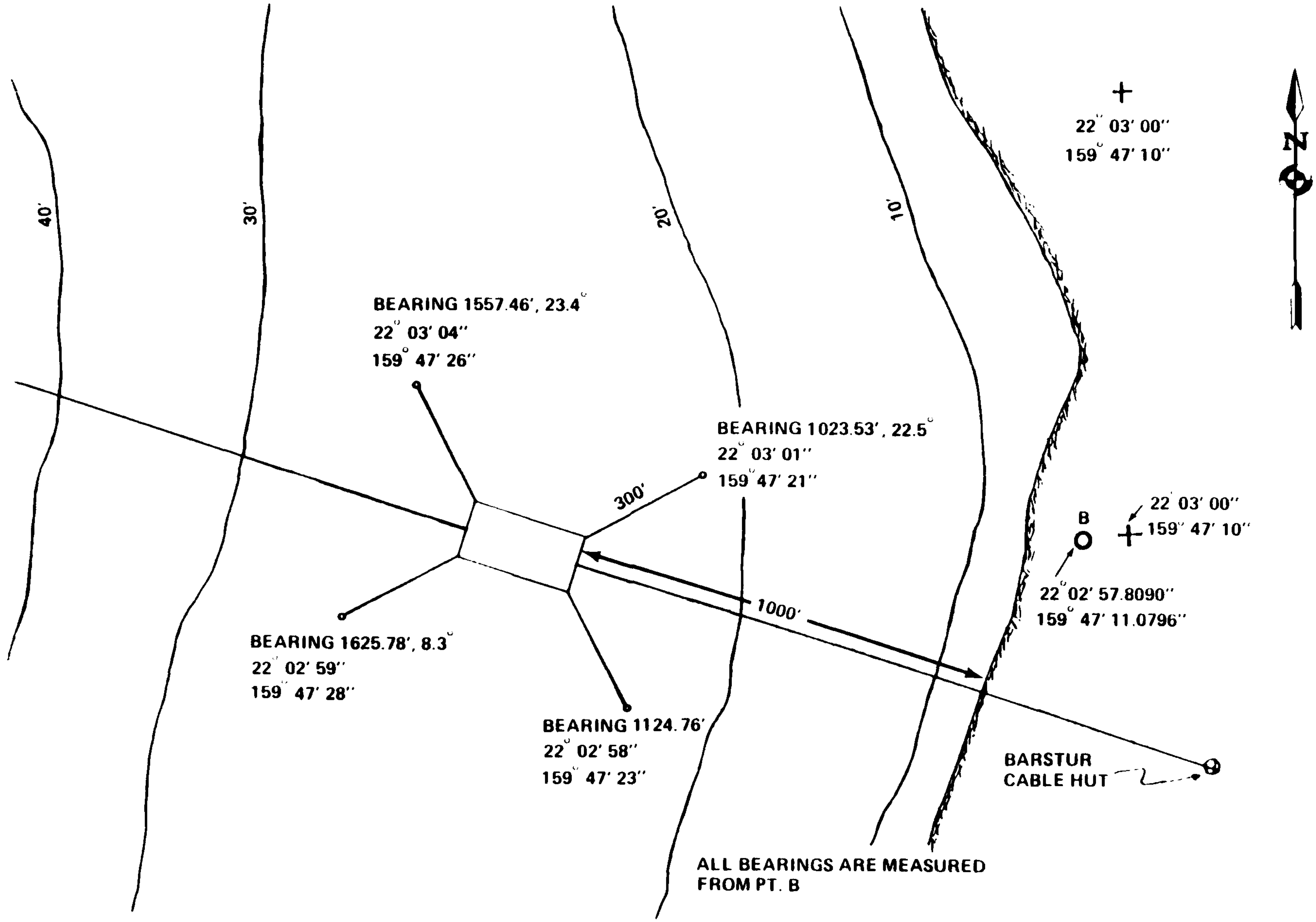


Figure A-1. BARSTUR 4 Point Moor and Offshore Cable Layout

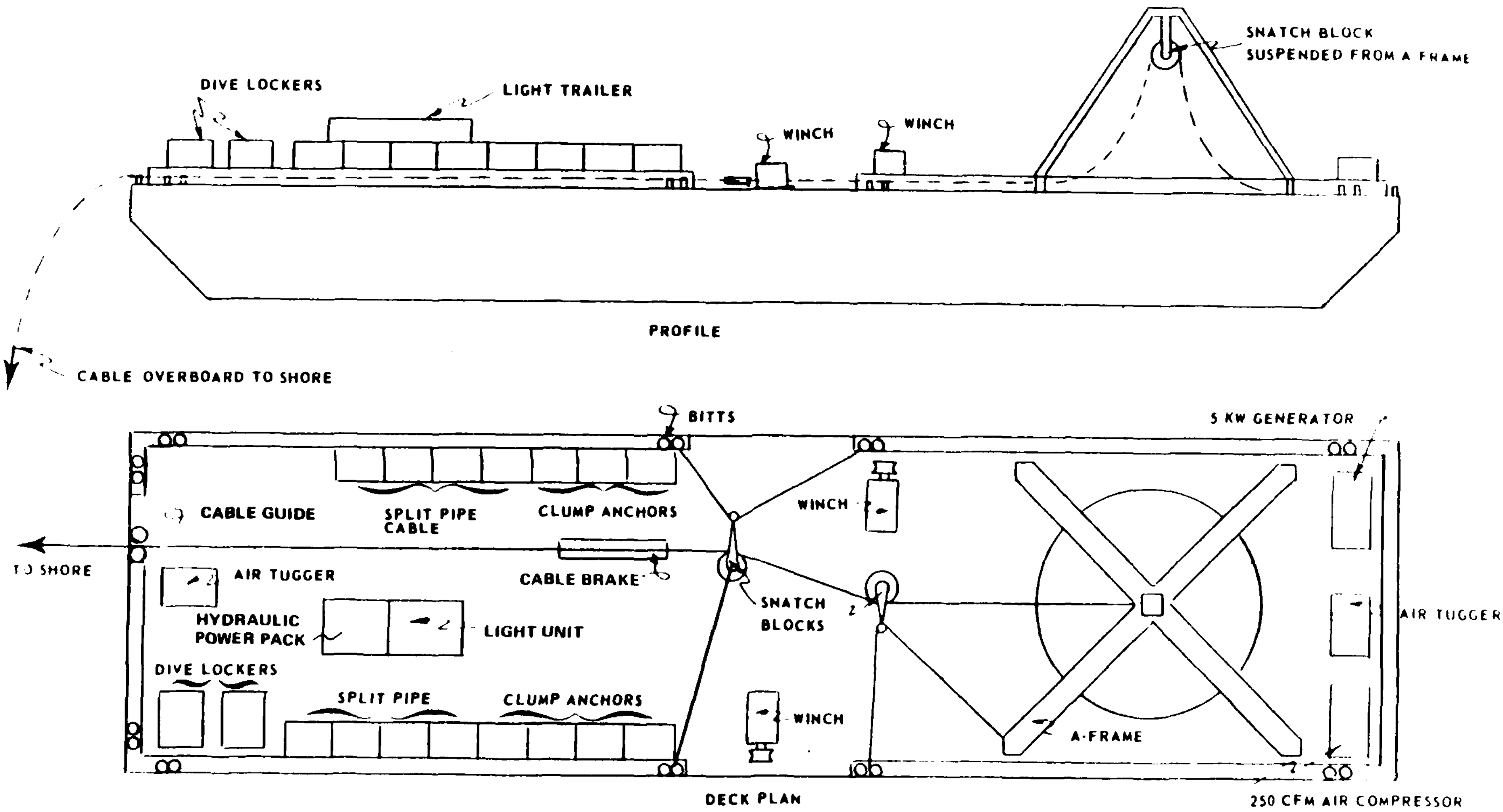


Figure A-2. Barge Deck Layout

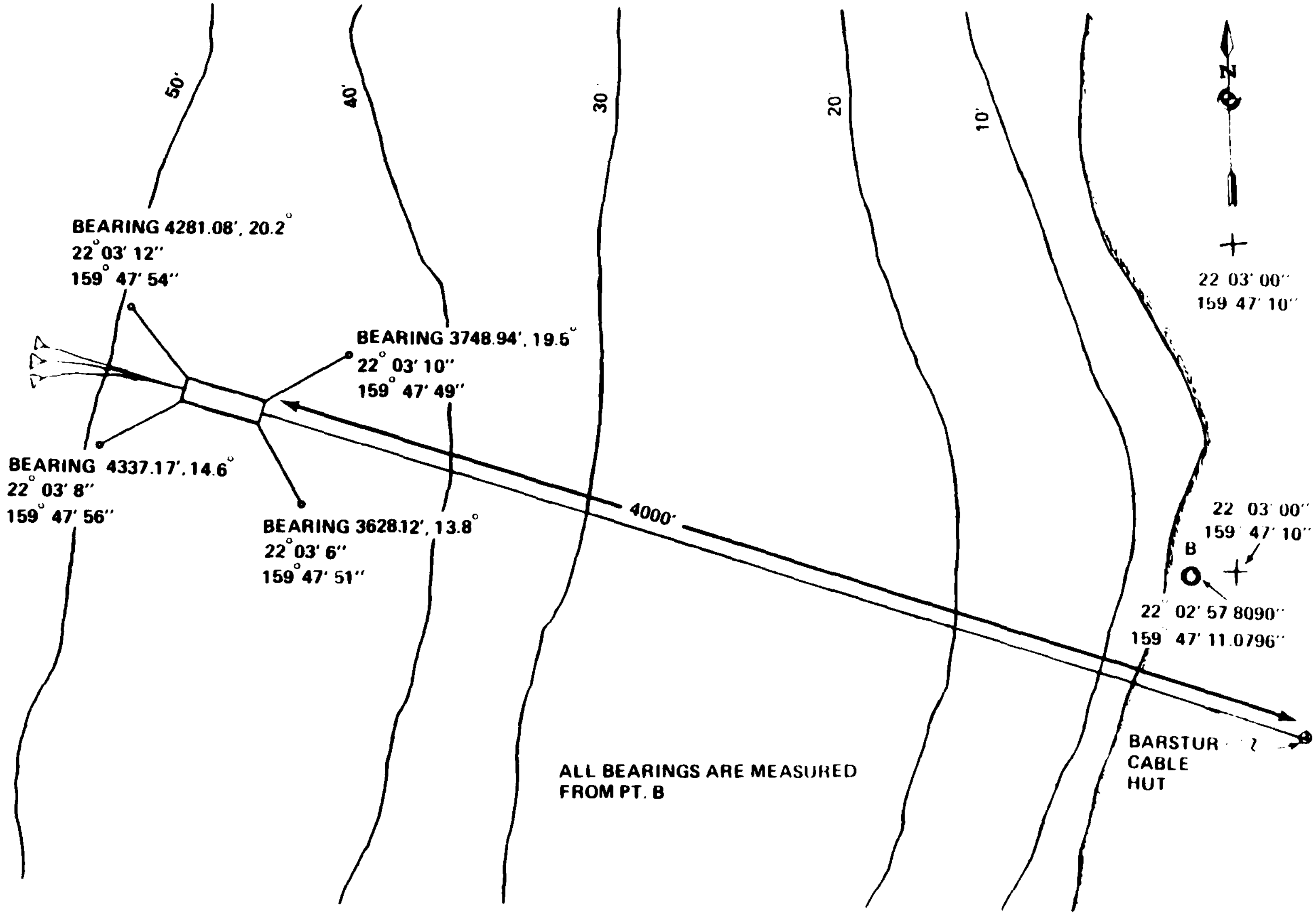


Figure A 3. BARSTUR 4 Point Moor and Offshore Cable Layout

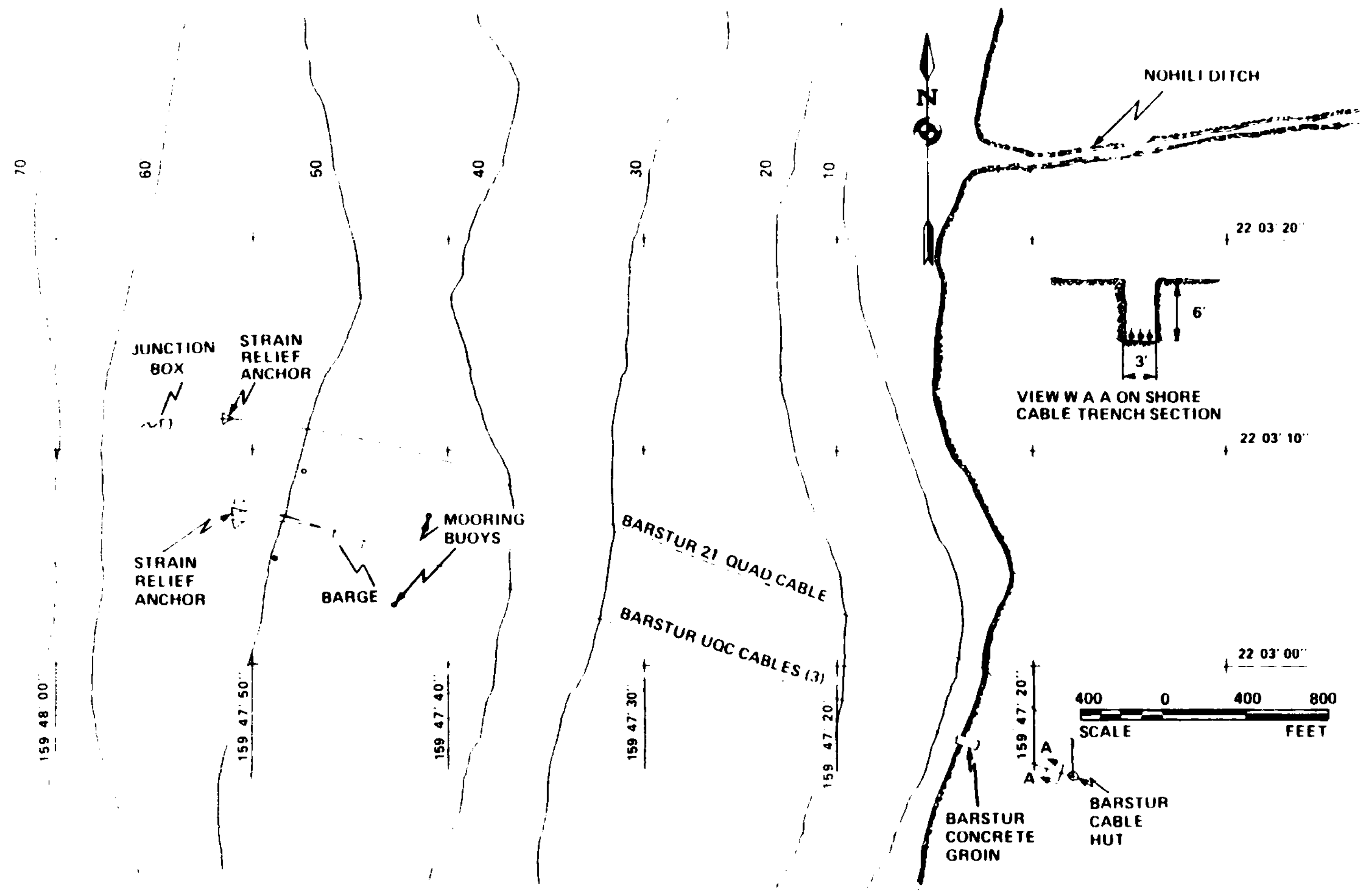


Figure A-4. BARSTUR Cable Repair 4 Point Moor and Inshore Cable Layout

APPENDIX B

MATERIAL AND EQUIPMENT

CHESDIV

15 TON SWIVEL
CABLE BEACH SHEAVE
36" × 12"
FLOAT BALLOONS
AIR TUGGERS
PROPELLANT EMBEDMENT
ANCHORS
24" SHEAVES
6" SAMPSON
SPLIT PIPE FASTENERS
SPLIT PIPE
CABLE TRANSPORTER
BARTELL
6" NYDAC
LIFT BAGS – Pr2 (Pr1V)
WINCH 20K
BATTERY CHARGER
MINI RINGER, (EDM)
HYDRAULIC POWER PACK
30K WINCH
SPLIT PIPE CAGE ASSEMBLIES
ROCK BOLTS

UCT-2

200' HYD HOSE
HD 20
DRILL BITS 1 1/2" × 24"
DIVE WEIGHTS
GENERATOR 5KW
CINST. TOOL KIT MINI
MECH. KIT METRIC
BU KIT
DIESEL TEST & SERVICE
EF COM
FIRST AID KIT
6" WATER PUMP
LARC HYD INTENSIFIER
(200 PUMKIN FLT.)
ADPT. CHUCK
BLT STOPPER
HOSE REEL
HPU
KIT 13
BAND SAW
SPLIT PIPE KIT
IWOG
ADMIN MINI KIT
SCUBA TANKS

UCT-2 (Cont'd)

AUTO EQUIP. KIT
CHILI KIT
EA MINI KIT
HPD W/R. PARTS
OUTBOARD MAINT. KIT
CEL EPOXY GUN
RADIO KIT (PRC 77)
CHAMBER CONFIG. 2A
SCUBA REPAIR KIT
CEL CABLE LOCATOR
(25/1000 HZ)
DV HAND TOOL KIT W/MAN.
CEL LIFT BAG
DPVs W/ BATT&CHARGER
CABLE BREAK
WIRE ROPE CLIPS
25 HP OUTBOARD W/R PARTS
LIGHT PLANT PORTABLE
ZODIAC 13'
HARDEYES
JEEP 4WDR.
SNATCH BLOCK
LARC 5 W/R PARTS
SHACKLES
LARC 15 W/R PARTS
U/W WEIGHT HAND KIT
DV SUP KIT
COME ALONG
QUICK RELEASE
SWEDGE KIT 5/8"
FISH TAPE 200'
DV BRIGHTS
42" BEACH SHIVE
PEANUT FLOATS
LUB SKID
WATER COOLERS
THERMOS
U/W CAMERA KIT
RADIOS (DRC-77)
WATER PUMP 1500
WIRE ROPE CUTTER
HYDRAULIC 1 1/2
OCEI RADIOS
FLOAT BALLOON (CABLE)
PVC CLAMPS
CABLE BRAKE
BOSUN LOCKER

PMRF/HAWAII

CLUMPS & CHAINS
(PMRF)
BULLDOZER
(PMRF)
BACKHOE
(PMRF)
MOORING BUOYS
(PMRF)
TUG BOATS
(MSC HONOLULU)
BARGE
(PEARL HARBOR)
CRANE
(PMRF PORT ALLEN)

APPENDIX C

PHYSICAL ENVIRONMENT

Environmental Data for the Kauai Cable Landing Site Barking Sands, Hawaii

Source of Data

Physical Environment of the Pacific Missile Range Facility, Kauai, Hawaii
Chesapeake Division
Naval Facilities Engineering Command
Washington, D.C.

FPO-1-84 (5) March 1984
Philip Vitale

I. INTRODUCTION

This report describes the physical environment at the PMRF, Kauai, Hawaii. Figure C-1 is a location map. The purpose of the report is to provide information which can be used to better protect present and future cable landings at the PMRF.

Information needed for proper design of cable protection includes wind data, and nearshore current estimates. The National Climatic Data Center has provided summaries of six years of wind data collected at the PMRF. Wave data are less abundant and are contained in several sources including the wave climate put together by Marine Advisers (1964); the daily visual observations made at the PMRF since 1968; and an offshore wave gage installed in October 1982. Limited nearshore current data are available from several sources.

In this report, the climate of the study area including precipitation and temperature is discussed. Wind and wave data are tabulated and analyzed and directional and seasonal trends are identified.

II. CLIMATE

The island of Kauai lies just south of the Tropic of Cancer within the northeast trade wind zone. The climate is generally mild due to the surrounding ocean and only two meteorological seasons are noticeable. Summer begins in April and lasts through November and is characterized by the strong northeast trade winds. Winter brings a weakening of these trade winds and the appearance of southwesterly winds and fronts from the north temperate zone.

As shown in Figure C-2 from the amount of rainfall varies widely over the island due to the influence of Mt. Waialeale. As the moist trade winds move over the mountain, they rise into the cooler higher elevations. The cooler temperatures cause the air to lose much of its moisture in the form of rain. This type of precipitation is known as orographic precipitation, which is also responsible for the rains of the Pacific Northwest. The areas to the west of the Mt. Waialeale range, therefore, receive much less precipitation than the rest of the island.

For example, the annual rainfall at the Mana station (1026 on Figure C-2) on the west side of the island, which is close to the PMRF, is 21.58 inches. At the Mt. Waialeale station (1047 on Figure C-2) the annual rainfall is 466 inches. Figure 3 shows the monthly precipitation values at the Mana station. The wet months are the winter months of December through March.

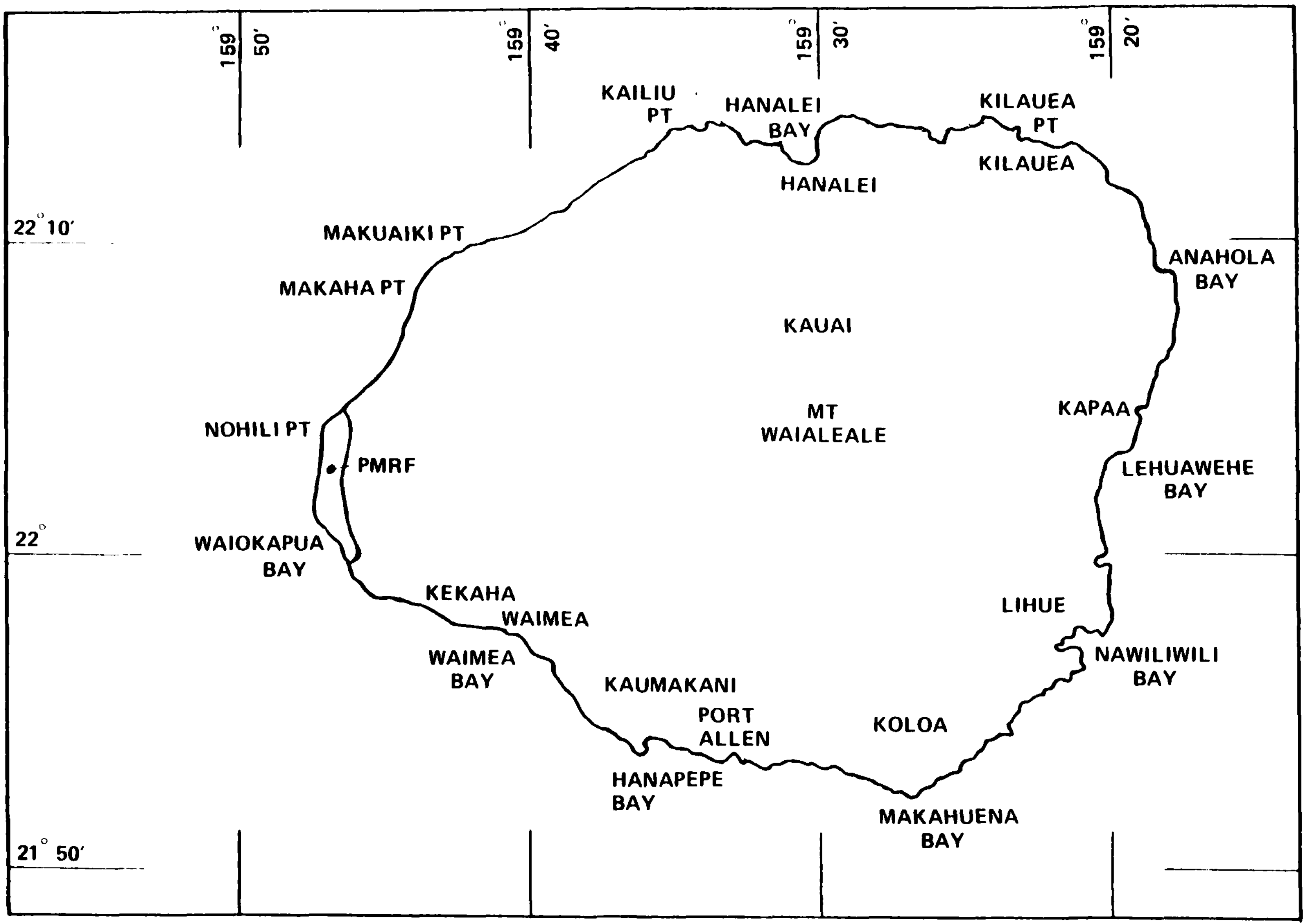


Figure C-1. Location Map, Pacific Missile Range Facility, Kauai, Hawaii

KAUAI

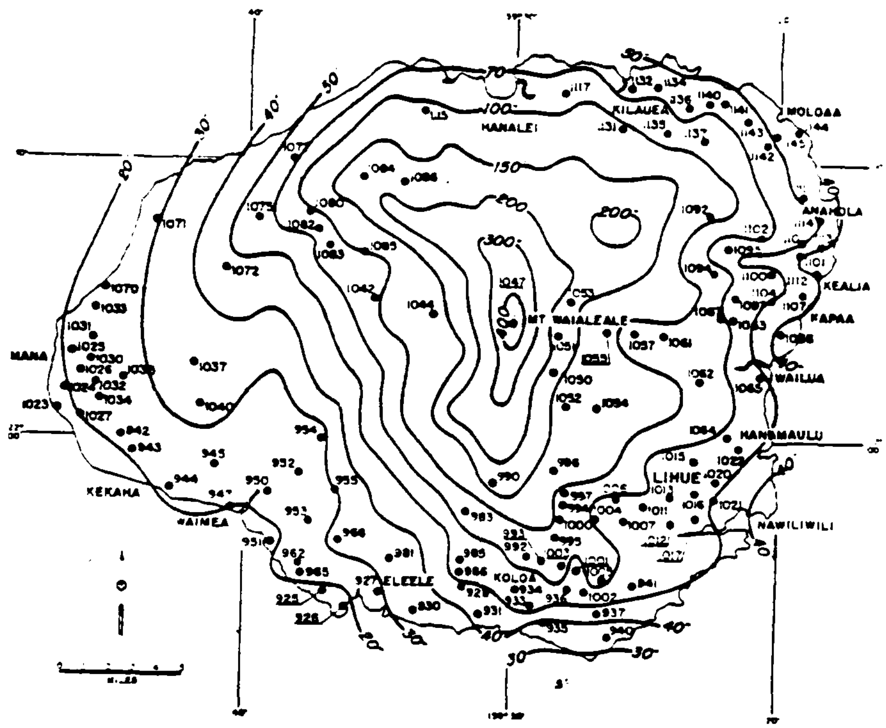


Figure C-2. Annual Rainfall Values with Isolines and Weather Station Numbers

The temperature of the island varies little over the year. The mean yearly temperature at the Mana station is 74.2°F, with a range in mean monthly temperatures of 70.1°F in January to 78.1°F in August. Figure C-3 is a plot of the mean monthly temperature for the Mana station.

Tropical storms are cyclonic disturbances of tropical origin in which maximum sustained winds have exceeded 34 knots. Hurricanes are similarly defined but with sustained winds exceeding 64 knots. An analysis of seven years of data shows no well defined tropical storms or hurricanes in the 5° latitude-longitude square in which Kauai is located. The adjacent 5° square, however, shows approximately an 11 percent chance of a tropical storm or hurricane heading toward Kauai. Until an analysis with a larger data base is accomplished, the 11 percent figure can be used as a rough approximation. This produces a return period of about 9 years for a tropical storm or hurricane.

In November 1955, an extra tropical storm dropped 20 inches of rain on Kauai in 13.5 hours while a January 1956 storm dropped 40 inches of rain in 30 hours. Hurricane Hiki, August 1950, recorded winds of 68 miles per hour on Kauai with 52 inches of rain falling in four days.

Hurricane Della, September 1957, passed a few hundred miles west of Kauai but caused heavy surf along the southern shores with waves 21 feet high for periods of 18.5 seconds. Hurricane Nina, December 1957, produced winds of 90 mph, 20 inches of rain in 14 hours, and large waves along the soutn shore. Hurricane Iwa, November 1982, brought winds of up to 80 miles per hour but dropped only 3 inches of rain on Kauai while causing record dollar amounts of damage.

The tidal range is small. For nearby Waimea Bay (see Figure C-1), gives a mean tidal range of 1.0 feet and a mean spring range of 1.6 feet. Sea level rise is estimated to be only 0.005 feet per year, based on data collected at Honolulu since 1905.

III. WIND DATA

The winds of Kauai are dominated by the northeast trades with different patterns evident during the two meteorological seasons. The summer months of April through November are a time of strong northeast trade winds. Winter brings a weakening of the trade winds and the appearance of southeasterly winds and fronts from the north temperate zone. Winter is also the most likely time for the so-called Kona weather, which is characterized by intense winds and waves from the southwest due to local fronts or Hawaiian lows of extra-tropical origin. During the summer 80 percent to 90 percent of the winds are due to the trade winds. During the winter the percentage drops to 50 percent to 80 percent.

Figure C-4 presents the yearly average of offshore wind data as collected over a ten-year period from marine deck observations. the predominance of the northeast trade winds is striking; winds are from the northeasst and east 75 percent of the time.

Nearshore winds on the other hand have quite a different distribution. Figure C-5 shows wind data collected at the PMRF meteorological station during the years 1966 to 1972 The percentage of winds from the northeast and east have been significantly reduced due to the local topography. The PMRF is located on the western side of the

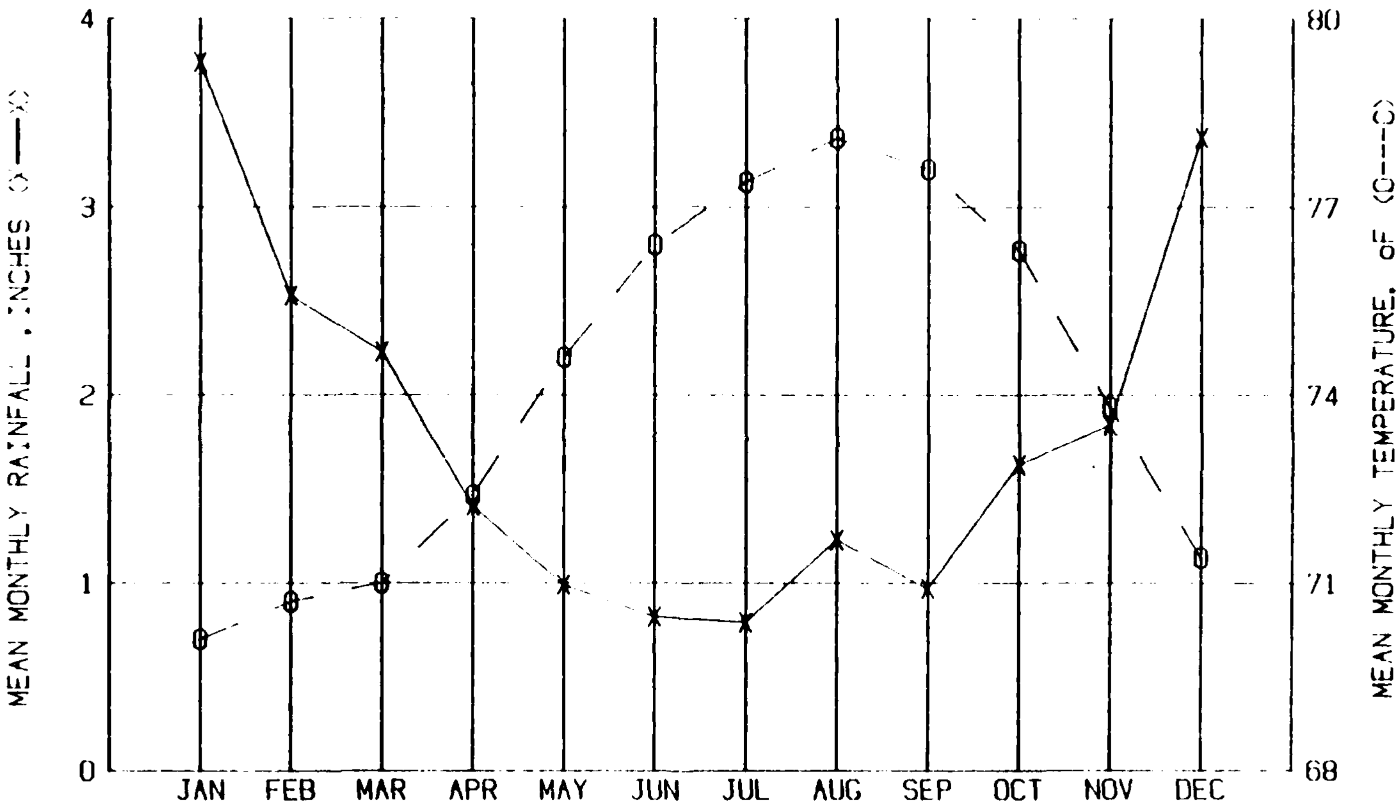
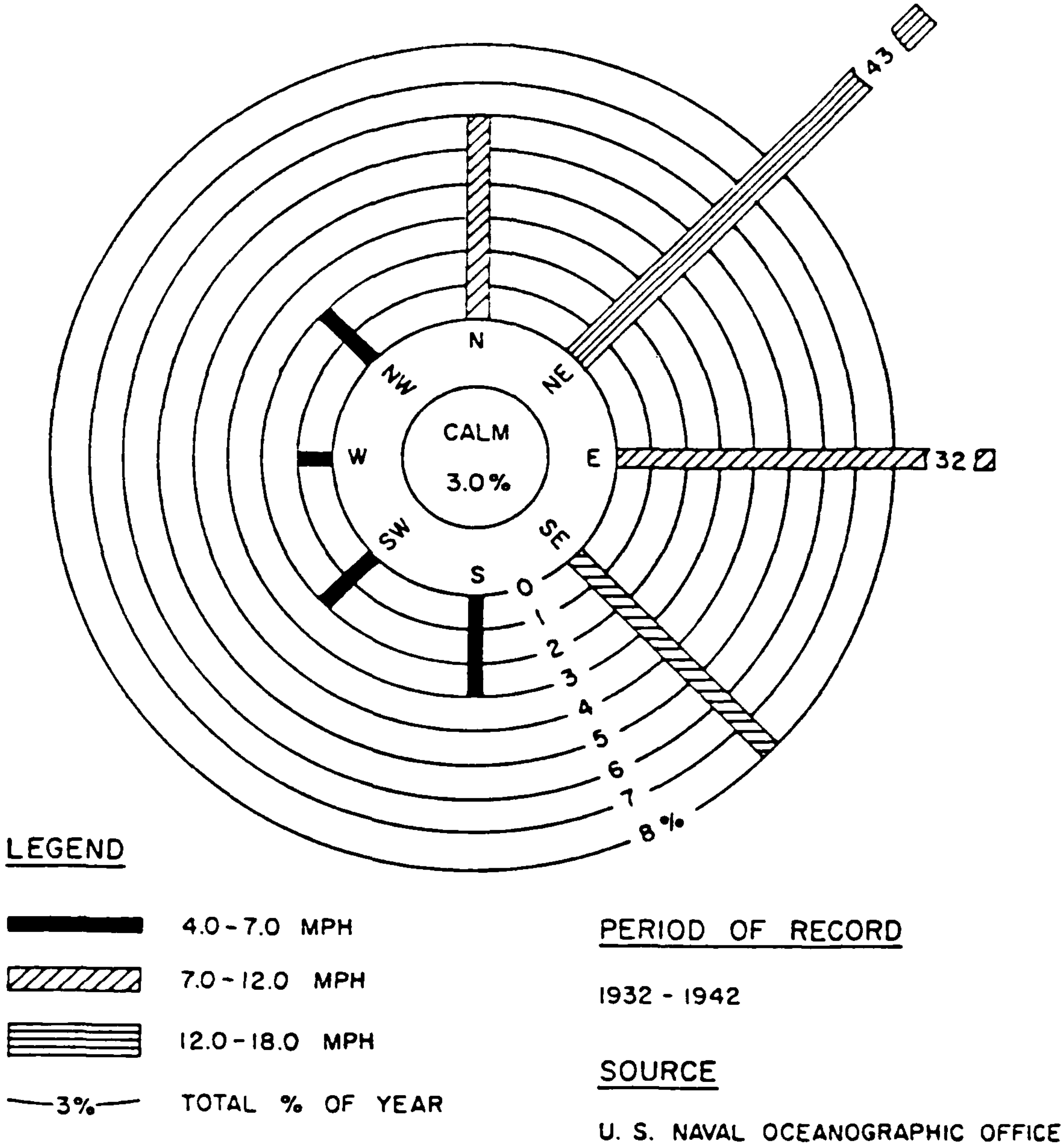


Figure C-3. Monthly Climatic Trends, Mana Station, Kauai, Hawaii

island of Kauai which has mountainousterrain dominated by Mt. Waialeale with an elevation of 5080 feet. The coastal plain, on which the PMRF beach lies on the seaward edge, lies directly at the base of large coastal cliffs. Therefore, the PMRF is significantly sheltered from the northeast trade winds. Figure 5 shows that the strongest winds come from the north but the largest percentage of winds come from the west. Fifty percent of all wind observations are from the west to north quadrant.

Study of the monthly wind roses, Figures C-6A through C-6D, shows the predominance of westerly winds during the summer months, and northerly to northwesterly winds during the winter months. Also, during the winter months, significant winds come from the south to southeast.

With regard to design winds, the American National Standards Institute presents a 50-year wind of 80 mph. The National Research Council (1983) studied the effects of Hurrican Iwa and presented Figure C-7 to show the recorded wind speeds on Kauai. Note that the winds do not exceed the 50-year wind.



OFF-SHORE WIND DIAGRAM
(YEARLY AVERAGE)
BARKING SANDS

Figure C-4. Offshore Wind Data

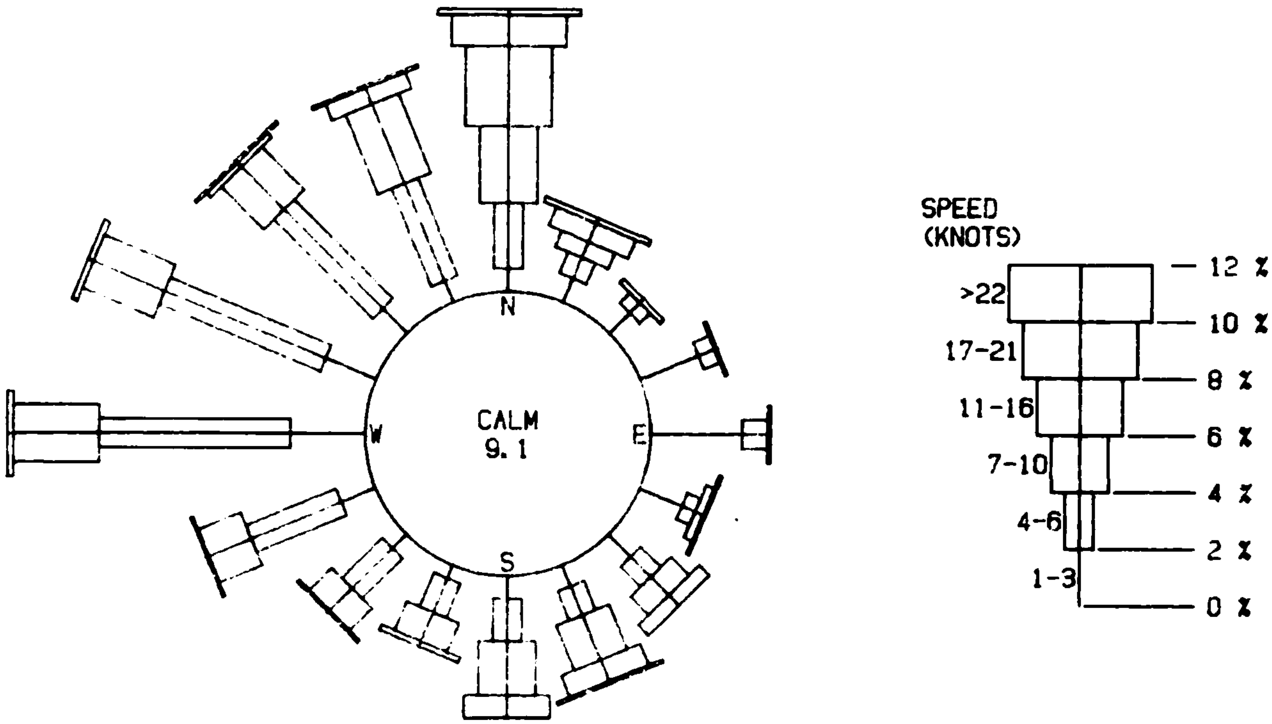


Figure C-5 Wind Rose, Barking Sands, All Months, 1966-1972

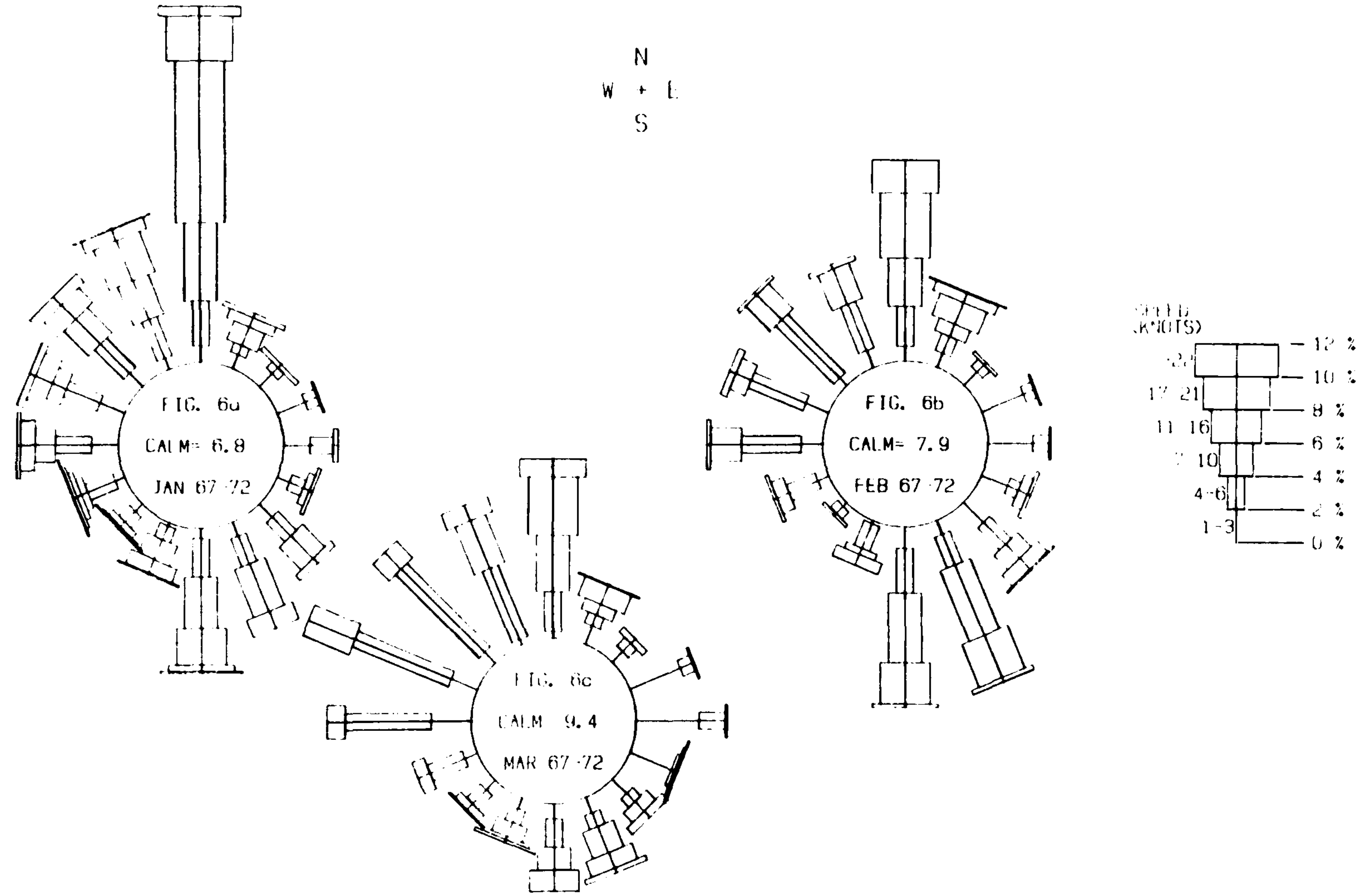


Figure C-6a Wind Rose, Barking Sands

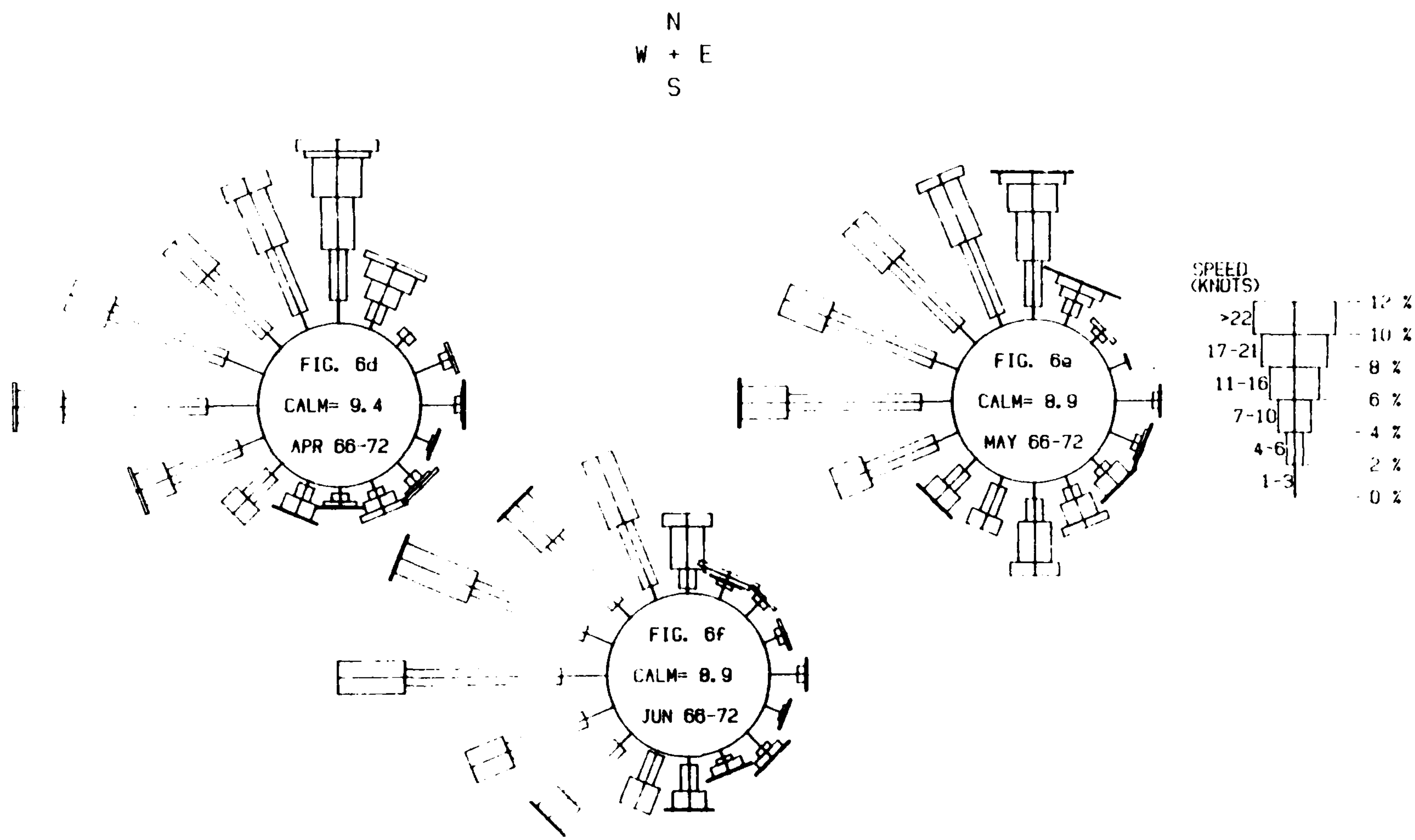


Figure C 6b Wind Rose, Barking Sands

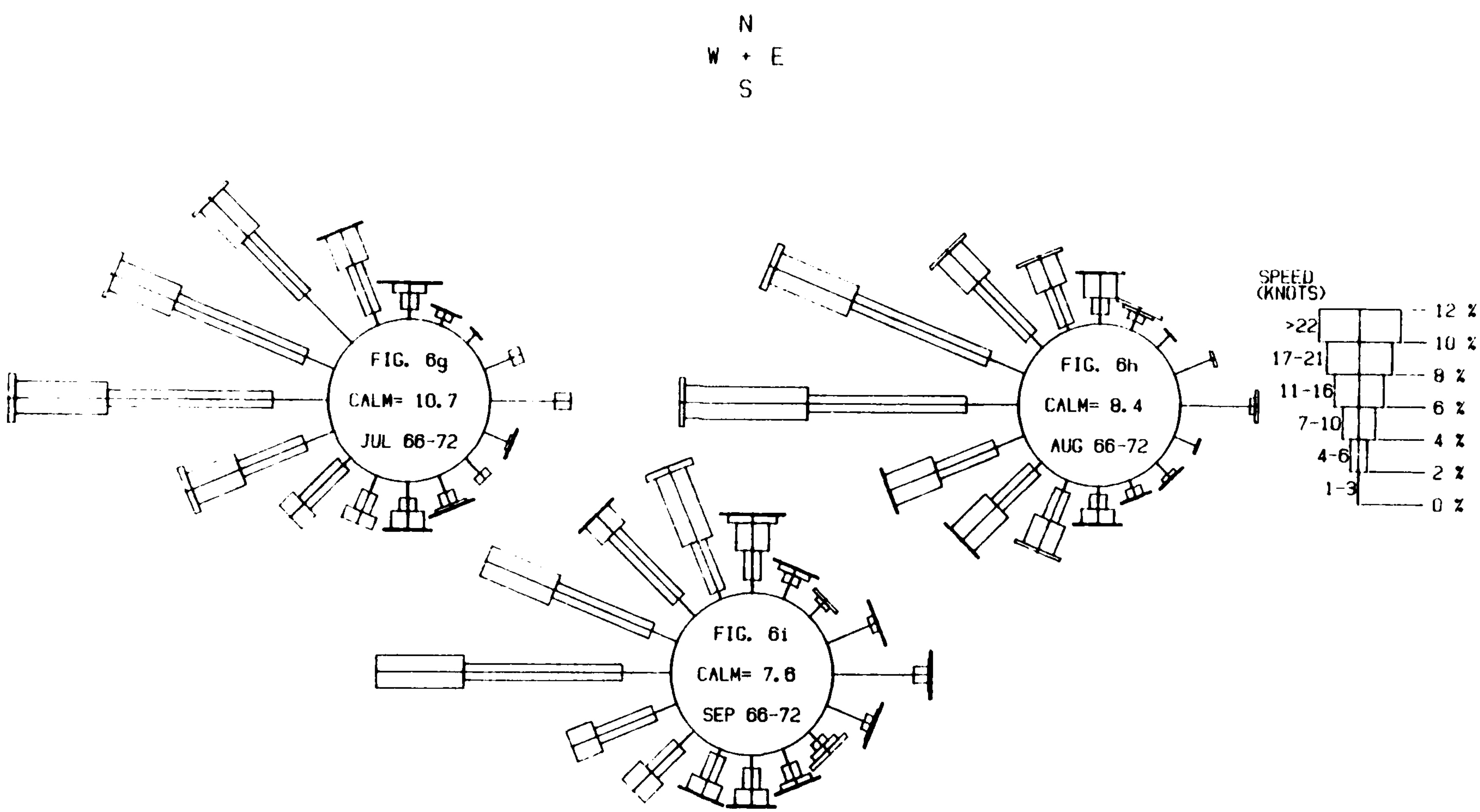


Figure C-6c Wind Rose, Barking Sands

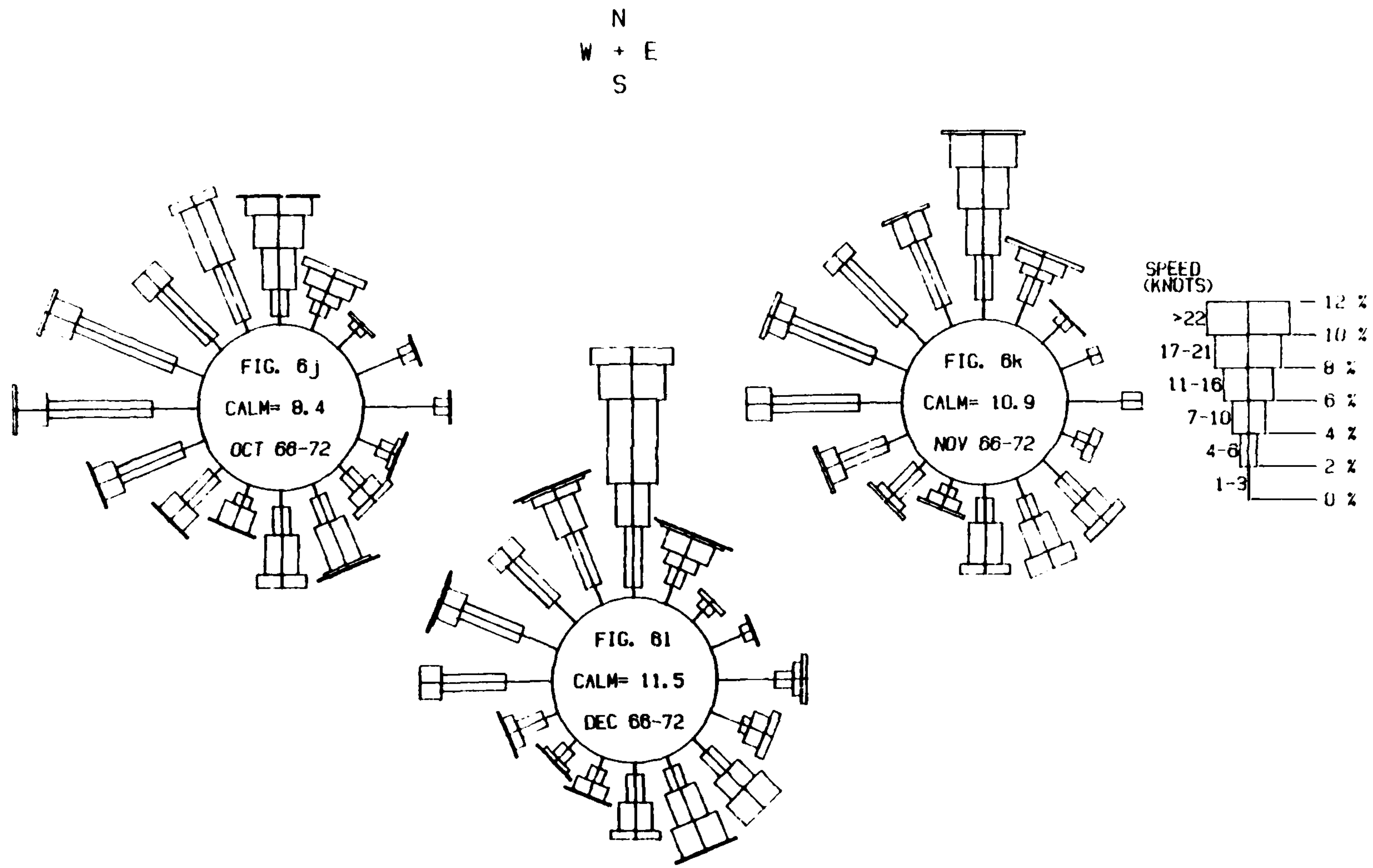


Figure C-6d Wind Rose, Barking Sands

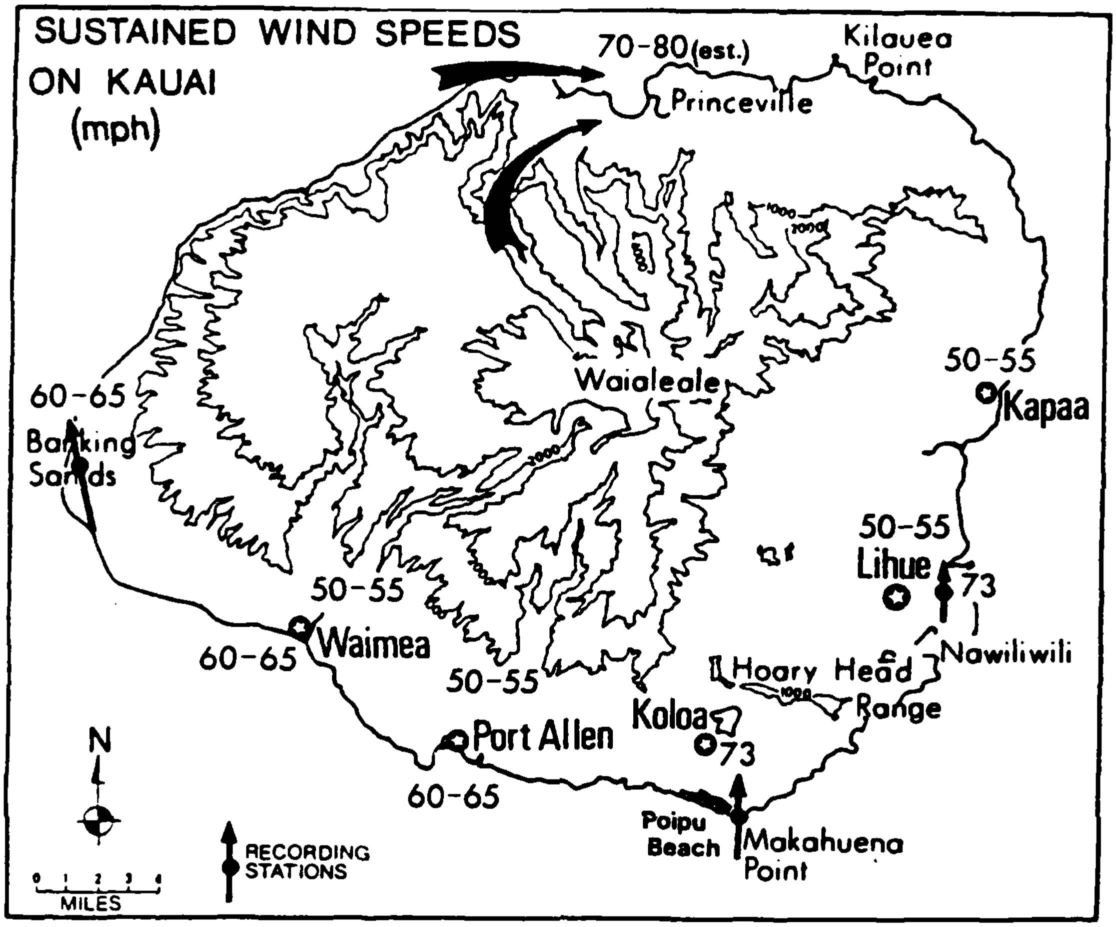


Figure C-7 Hurricane IWA Wind Velocities

WAVE DATA

A. Wave Types.

The Hawaiian Islands are regularly subjected to four types of wind waves or swell: northeast trade waves, southern swell, Kona storm waves, and North Pacific swell. Figure C-8 shows the range of approaches of these waves.

The northeast trade waves are generated by the prevailing northeast trade winds. They occur throughout the year but are most intense during the summer months of April through November at Kauai. The waves are long and low, with heights of only 1 to 4 feet but periods of 14 to 22 seconds. Their approach is from the southeast to southwest.

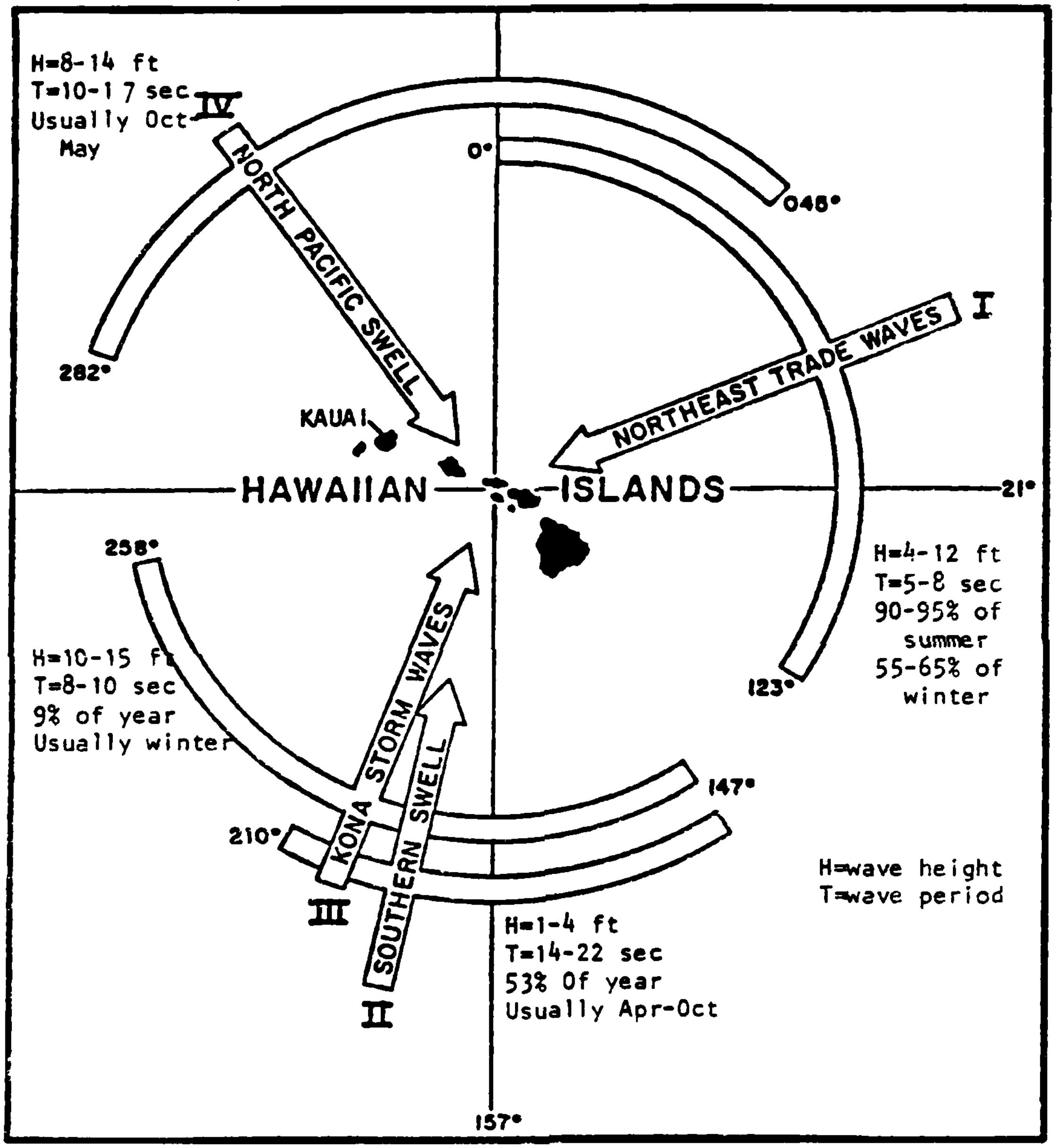


Figure C 8. Hawaiian Wave Types

Kona storm waves are generated by intense winds due to local fronts or Hawaiian lows usually during the winter and the waves are 10 to 15 feet high with periods of 8 to 10 seconds. The direction of approach is form the southeast to west with the largest waves coming from the southwest. Kona waves occur infrequently, only 9 percent of the time in a typical year, but their intensity makes them a significant factor in the coastal processes of Kauai.

North Pacific swell are products of storms in the Aleutians and of mid-latitude lows. They occur throughout the year but are most intense and numerous during the winter months of October through May. Wave heights are 8 to 14 feet with periods of 10 to 17 seconds. The direction of approach ranges from northwest to northwest. North Pacific swell are some of the largest waves which reach Kauai.

Figure C-9 and Table C-1 present information covering the years 1955 to 1963 on storms which have affected the PMRF study area. Wave heights near the shoreline will be limited by the depth of water at the location of interest.

Kauai is subject to tsunamis seismically generated primarily in the Kamchatka - Kurile Islands - Aleutian Islands area in the Northern Hemisphere, and secondarily off the coast of Chile in the Southern Hemisphere. Tsunamis have historically caused considerable erosion and can move large chunks of coral reef material. The Corps of Engineers (1966) reports 41 damaging tsunamis in the Hawaiian Islands in the 146 previous years. Of these, 7 were very severe, 2 severe, 8 moderate, and 24 slight. The 1 April 1946 tsunami from the Aleutian Islands caused waves of 17 feet at Mana Point, 24 feet at Nohili Point, and 33 to 38 feet near Polihale. The 23 May 1960 tsunami from offshore Chile caused high water marks of 8 feet near Mana Point. More recent summaries of tsunamis were not found.

B. Wave Data.

The most complete set of deepwater wave data now available in the Kauai area is in Marine Advisers. The report was done for the island of Oahu but is applicable to Kauai since it is deepwater data and the effects of land masses were neglected. The data were not averaged over a number of years; rather, many years were studied to identify a "typical year" and then the data from that year is presented. However, a full "typical year" was not found. so a composite 'typical year' was put together. The summer of the composite year consisted of July through November of 1962 and April through June of 1963. The winter months included December 1952 and January through March 1951.

The waves for the summer months consisted of Northern Hemisphere swell and Southern Hemisphere swell. The winter months included Northern Hemisphere swell and waves. Kona waves were added in where appropriate. The data itself is a combination of visual observations, wave hindcasting, and wave gage data.

Figure C-10 is the annual wave rose for the Marine Advisors data. The predominant directions of wave approach are from the northwest, the east-northeast, the east, the south, and the south-southwest. However, separating the data into its winter and summer components presents a better picture of what can be expected during a certain time of year. Figure C-10 also shows the wave rose for the winter months. The effects of the northeasterly trade winds and the North Pacific swell are easily seen. Also, the large Kona waves from the south-southeast to the west-southwest are shown.

Table C-1: Deepwater Storm Data

Storm	Wind Speed (knots)	Fetch Length (naut mi)	Decay Distance (naut mi)	Minimum Duration (hours)	Deep Water Wave Height	Period (seconds)	Deep Water Wave Length (feet)	Direction
21 Dec 55	23	1,660	0	40	12.0	11.0	620	S 75° W
26 Nov 56	29	1,170	490	38	9.0	14.9	1,137	N 30° W
4 Sep 57[1]	78	140	190	8	21.0	18.5	1,751	S 78° W
13 Jan 58	40	2,000	430	80	27.6	21.5	2,366	N 55° W
18 Jan 59	22	730	0	57	12.0	11.6	689	S 67° W
19 Dec 60	31	1,610	50	38	17.4	13.7	961	N 28° W
8 Jan 62	27	1,800	0	48	16.6	12.8	839	N 40° W
17 Jan 63	30	1,320	0	73	22.0	15.3	1,199	N 49° W

[1] Hurricane

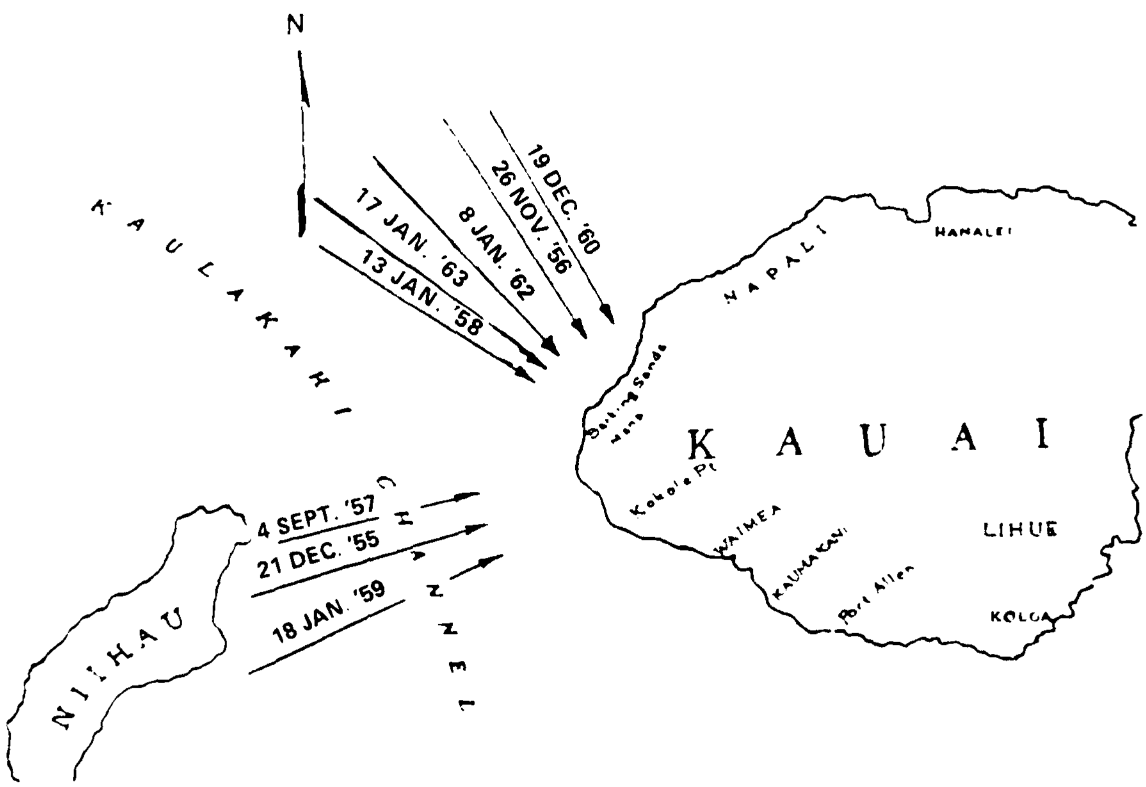


Figure C-9. Deepwater Storm Directions Towards PMRF

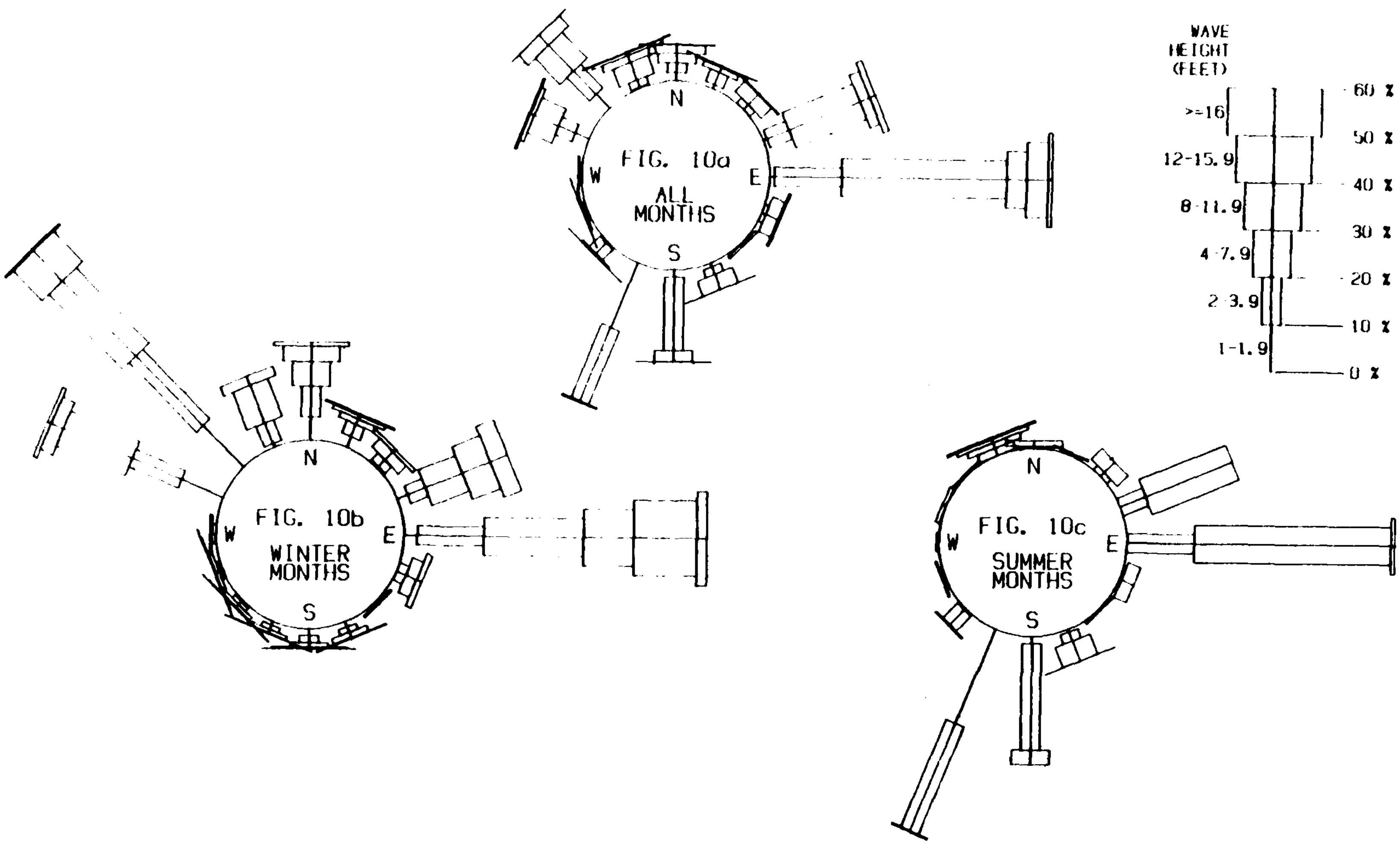


Figure C-10. Deepwater Wave Rose, Marine Advisors (1964)

The summer waves rose is plotted in Figure C-10. Again, the northeast trade waves are present but the North Pacific swell is diminished. The summer swell waves from the Southern Hemisphere appear from the south to south-southwest and are generally of low wave height.

PMRF Visual Observations: Beginning in July 1968, twice daily visual observations of surf conditions were made by PMRF personnel as part of their routine weather data collection. The data collected were significant wave height, maximum breaker wave height, wave period, percent plunging and spilling waves, and the angle of wave approach to the shoreline. The most useful data are the significant wave height and the wave period. The former is discussed below. Although the wave angle was estimated with each observation, most of the recorded values were zero. Therefore, the wave angle data will not be analyzed in this report.

The accuracy of visual observations of wave height is low. However, the fact that 15 years of data are available and have been averaged together should justify confidence in the data as a credible description of the general wave environment in the surf zone. The data are grouped by month.

Figure C-11 shows the distribution of wave heights as a faraction of all waves observed. For example, during January almost 25 percent of the waves were approximately 4 feet high. The more spread there is in the distribution, the more variation there is in the observed waves. The summer months of April through September show distributions concentrated more to the low wave height end of the abscissas than the winter months of October through March. The months of June, July, and August are particularly mild with most waves being 2 feet or less.

The same monthly variation can be illustrated by plotting wave heights in cumulative form. Figure C-12 shows the cumulative fraction of waves observed which were less than or equal to the wave height on the abscissa. The more the cumulative line tilts toward the right as it moves up, the higher the wave climate. Again, the difference between the October through March winter months and the April through September summer months is obvious.

The monthly variations over the year are compactly shown in Figure C-13. H_{10} is the wave height that is 10 percent of the observed waves were greater than. Similar definitions apply to H_{25} and H_{30}. Hmax is the maximum wave height observed. H_{50} is also known as the median wave height. The data plotted in Figure C-13 are listed in Table C-2. The milder wave climate during the summer is evident.

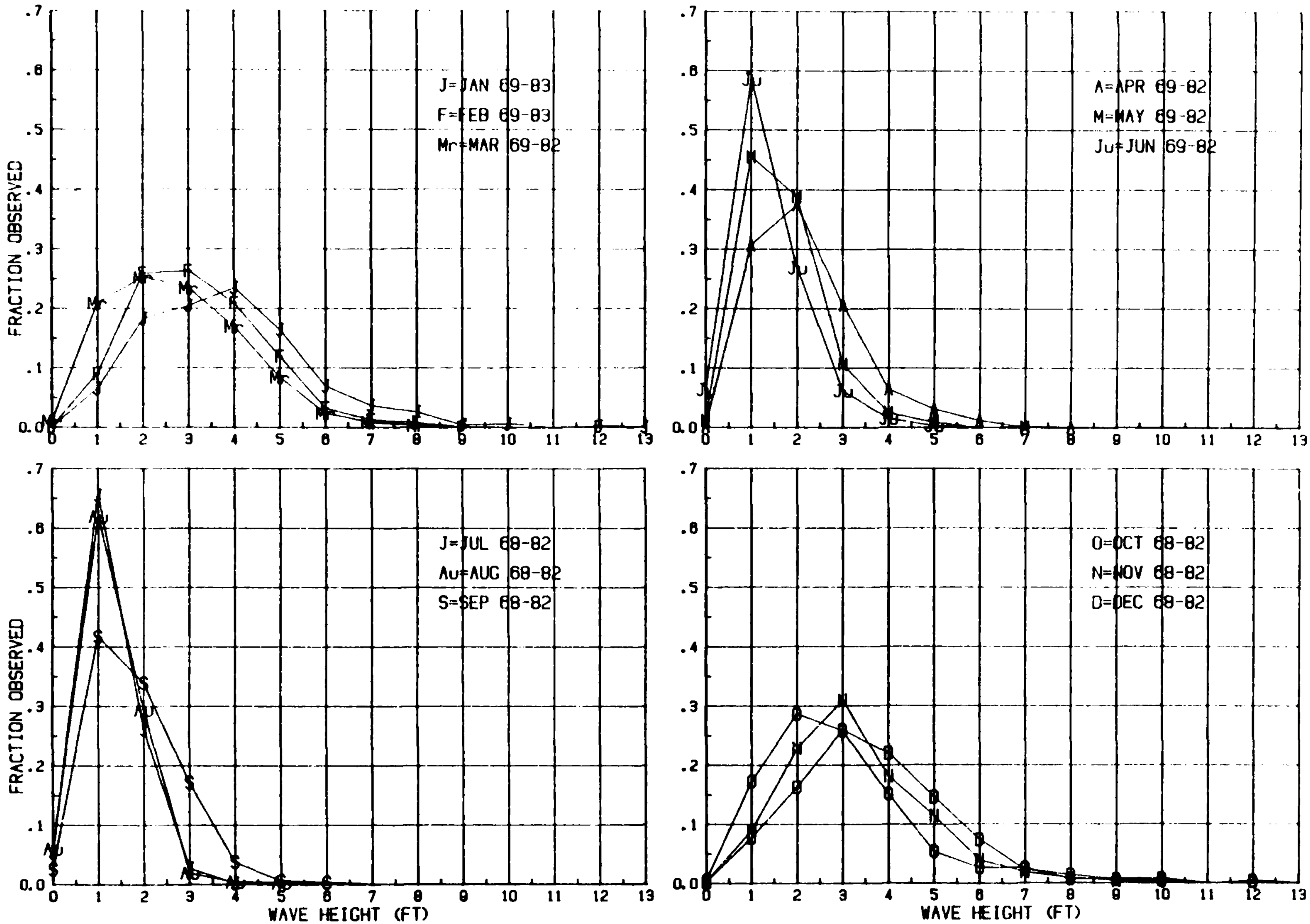


Figure C-11. Wave Height Distribution, Visual Beach Observatons

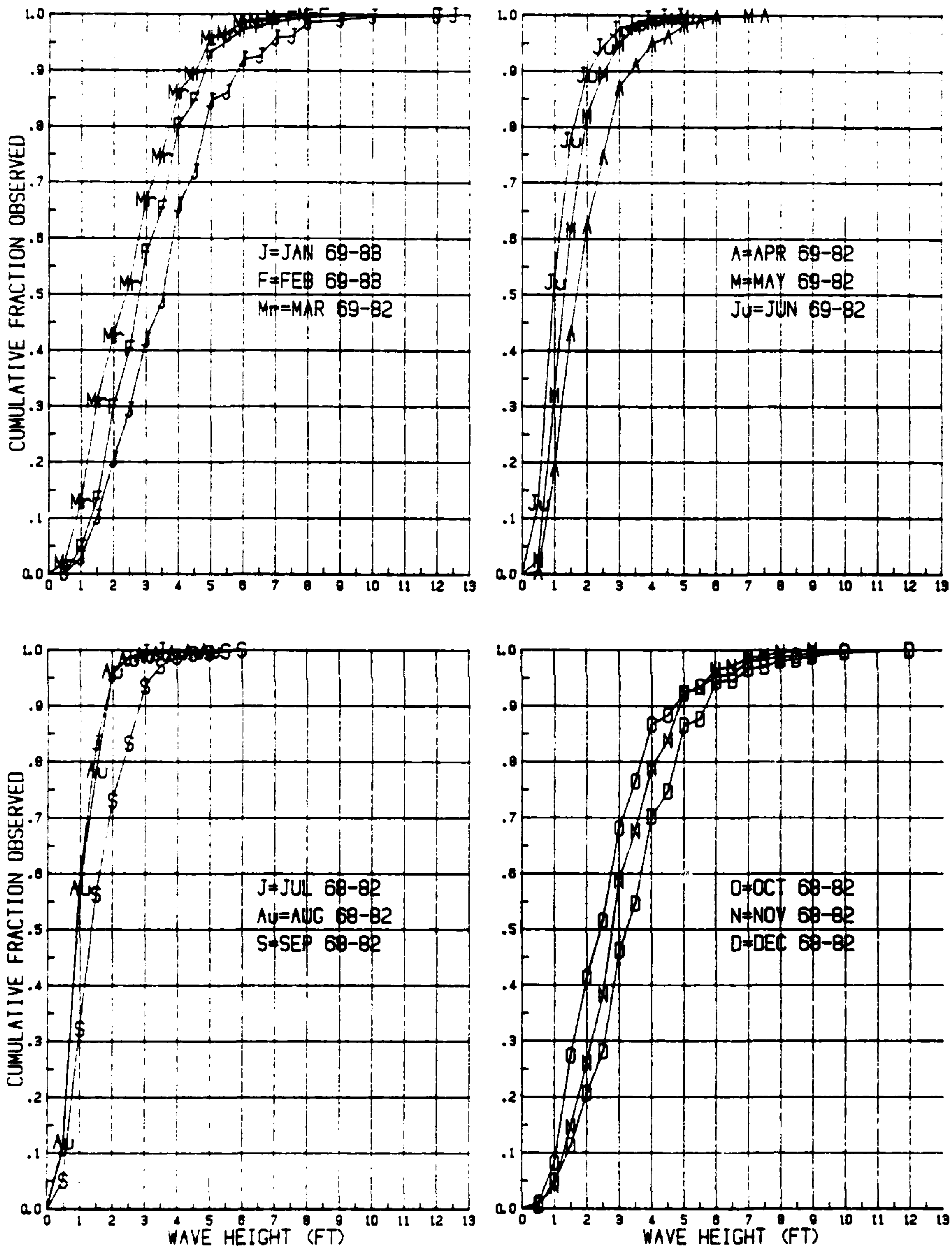


Figure C 12. Wave Height Cumulative Distribution, Visual Beach Observations

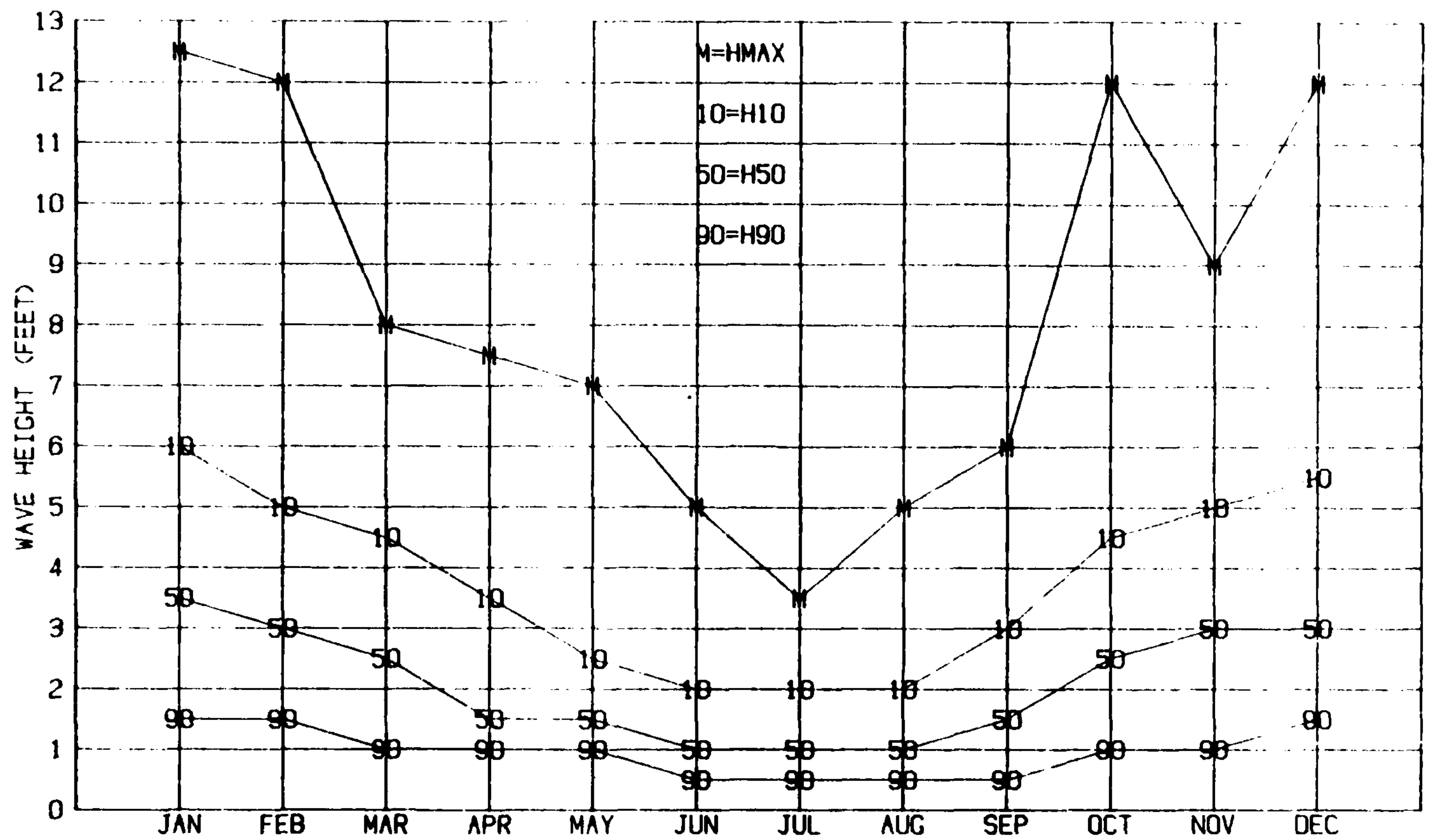


Figure C-13. Monthly Wave Climate, PMRF Visual Observation 1968-83

Table C-2: Monthly Wave Height Cumulative Values (feet).

MONTH	H_{90}	H_{50}	H_{10}	H_{max}
JAN	1.5	3.5	6.0	12.5
FEB	1.5	3.0	5.0	12.0
MAR	1.0	2.5	4.5	8.0
APR	1.0	1.5	3.5	7.5
MAY	1.0	1.5	2.5	7.0
JUN	0.5	1.0	2.0	5.0
JUL	0.5	1.0	2.0	3.5
AUG	0.5	1.0	2.0	5.0
SEP	0.5	1.5	3.0	6.0
OCT	1.0	2.5	4.5	12.0
NOV	1.0	3.0	5.0	9.0
DEC	1.5	3.0	5.5	12.0

V. CURRENTS

Coast and Geodetic Survey (1963) reports observed currents 0.5 miles off Mana Point to be 0.8 knots maximum to the south 3 hours after low water and 0.8 knots maximum to the north 3 hours after high water. Similar observations near the shoreline 3.5 miles southeast of Nohili Point showed the currents to be generally less than 0.5 knots.

Laevastu, Avery, and Cox (1964) summarized drogue measurements made of tidal currents around Kauai about 2 miles offshore in about 600 feet of water during 23-24 July 1963. Figure C-14 from that report shows how the tidal currents folw around Kauai. The flood currents are to the south-southeast at the PMRF site, and the north-northeast during ebb current. Maximum velocities were only one knot.

The Corps of Engineers (1966) reports that during a storm in March 1965 with waves approaching from the northwest, a southward nearshore current of 3 knots was observed along with a rip current.

Between October 1967 and October 1968, seven measurements were made of the longshore currents outside of the breaker line, according to the Corps of Engineers (1969). The readings were made 8 feet below the surface in 20 feet of water. All currents were less than 1 knot and to the south. However, within the breaker zone, the maximum longshore current was 3 knots.

The Naval Oceanographic Office set up three bottom-mounted current meters from 16 July to 5 August 1974 in 40 feet to 80 feet of water, 0.5 to 1 mile offshore of Nohili Point, as shown in Figure C-15 from Huddell and Willet (1977). The currents are seen to generally follow the direction of the bottom contours with a northeast-southwest orientation. Maximum currents were only 1 knot. The driving force of the currents was the tide, as depicted in Figure C-16 from Huddell and Willet (1977).

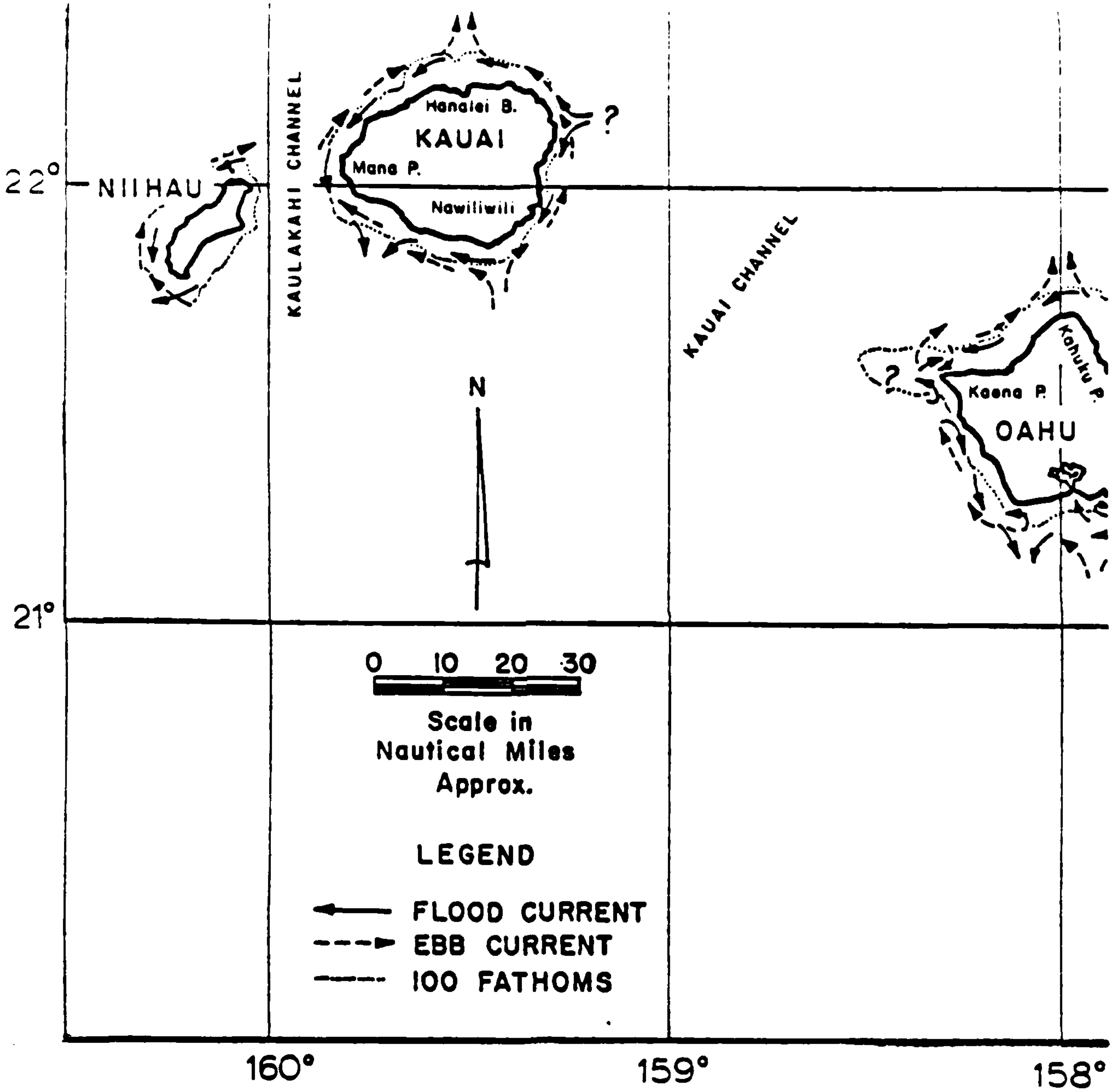


Figure C-14. Tidal Currents Around Kauai

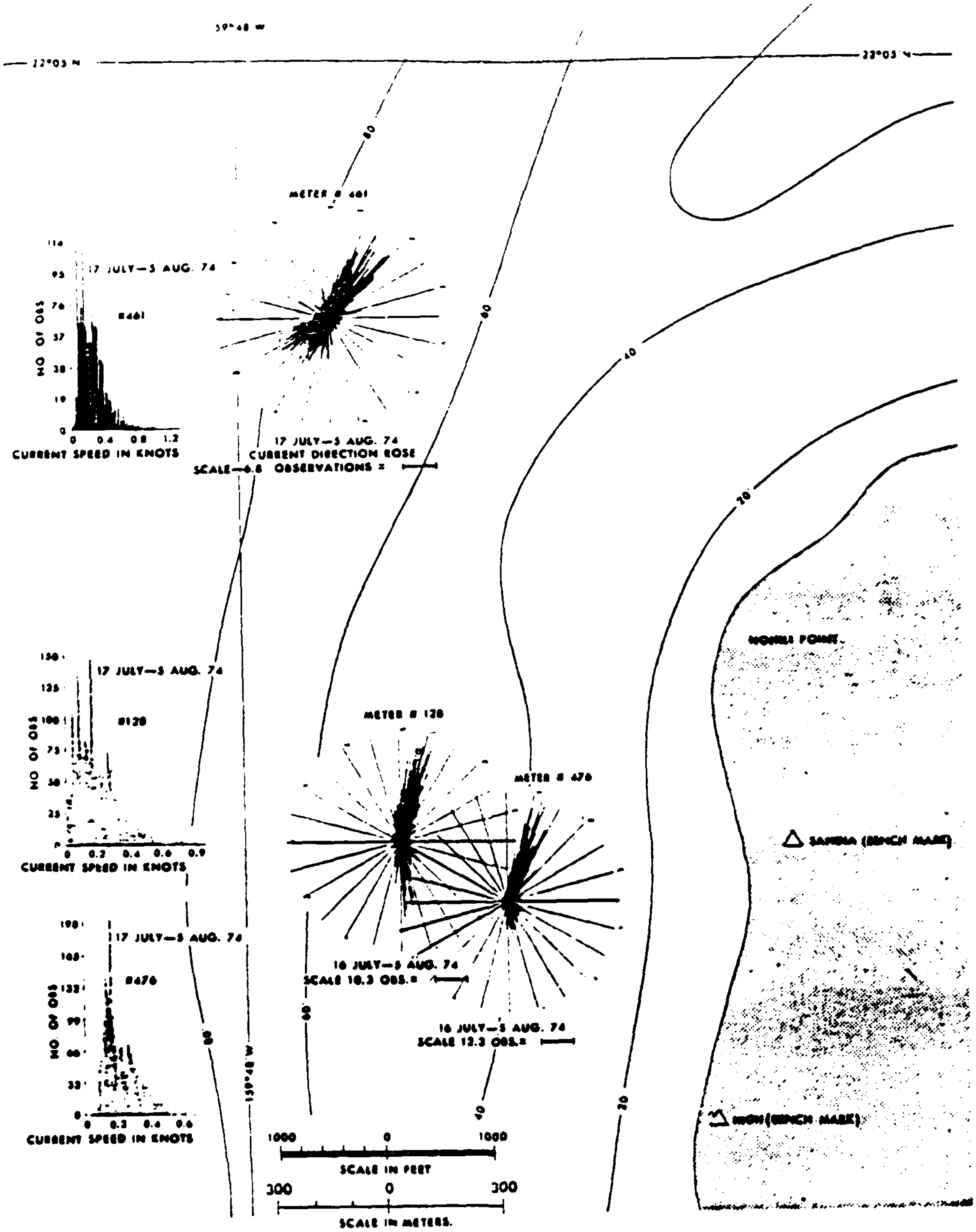


Figure C-15. Locations and Velocities of Tidal Current Measurements

The Corps of Engineers (1978) reported on two sets of nearshore current measurements taken in January 1977 near Kekaha. With a westerly swell of 5 to 8 foot breaker heights, the longshore current was southeasterly at 0.7 knots. The winds were light and variable. The second set of measurements were taken on a day when the winds were northeast trade winds and the waves were only 1 to 3 feet high. The currents were 0.4 to 1.5 knots to the west. These currents were not correlated with the tides.

From the above discussion, it is seen that nearshore currents are seldom more than 1 knot, except close to or within the breaker zone. In the latter case, currents of 3 knots were observed. Unfortunately, the number of observations is rather small and an estimate of a design current should be based on the wave climate and water depth at the point of interest with 1 knot added to account for the tidal current.

VIII. SUMMARY AND CONCLUSIONS

The climate of the PMRF site is mild due to the influence of the surrounding ocean, and dry due to the influence of Mt. Waialeale. There are only two meteorological seasons. The summer months are April through November, a time of strong northeast trade winds. The winter months are December through March, a time of lessened trade winds, increased southeasterly winds, and local storms. Tropical storms pass through approximately once every nine years.

The wind climate is dominated by the northeast trade winds, particularly during the summer months. Kauai's mountainous terrain, however, shelters the PMRF from many of these winds. ANSI standards give a 50-year design wind of 80 mph for Kauai.

Waves are composed of northeast trade winds, northern Pacific swell, southern swell, and Kona storm waves. Fifteen years of surf observations clearly indicate that the summer months have much milder wave climates than the winter months. A nearshore wave gage was installed near the PMRF in October 1983 and will produce an excellent data set from which a design wave can be selected. The Corps of Engineers is also working on a wave hindcast of the offshore area.

Nearshore current measurements are scarce. Those that have been taken give a maximum of 3 knots near or in the surf zone. However, design currents are best based on wave climate and water depth with one knot added for tidal current.

The best time of year to work at the PMRF site with regard to the wave environment is the summer, particularly during June, July, and August. However, summer is also the time of maximum beach sand thickness which makes work on the beach rock difficult. Therefore, if both large waves and beach sand are to be avoided, the early summer months of April and May are probably optimum. During these months, the waves are relatively low and the beach sand has not had much time to move back onshore.

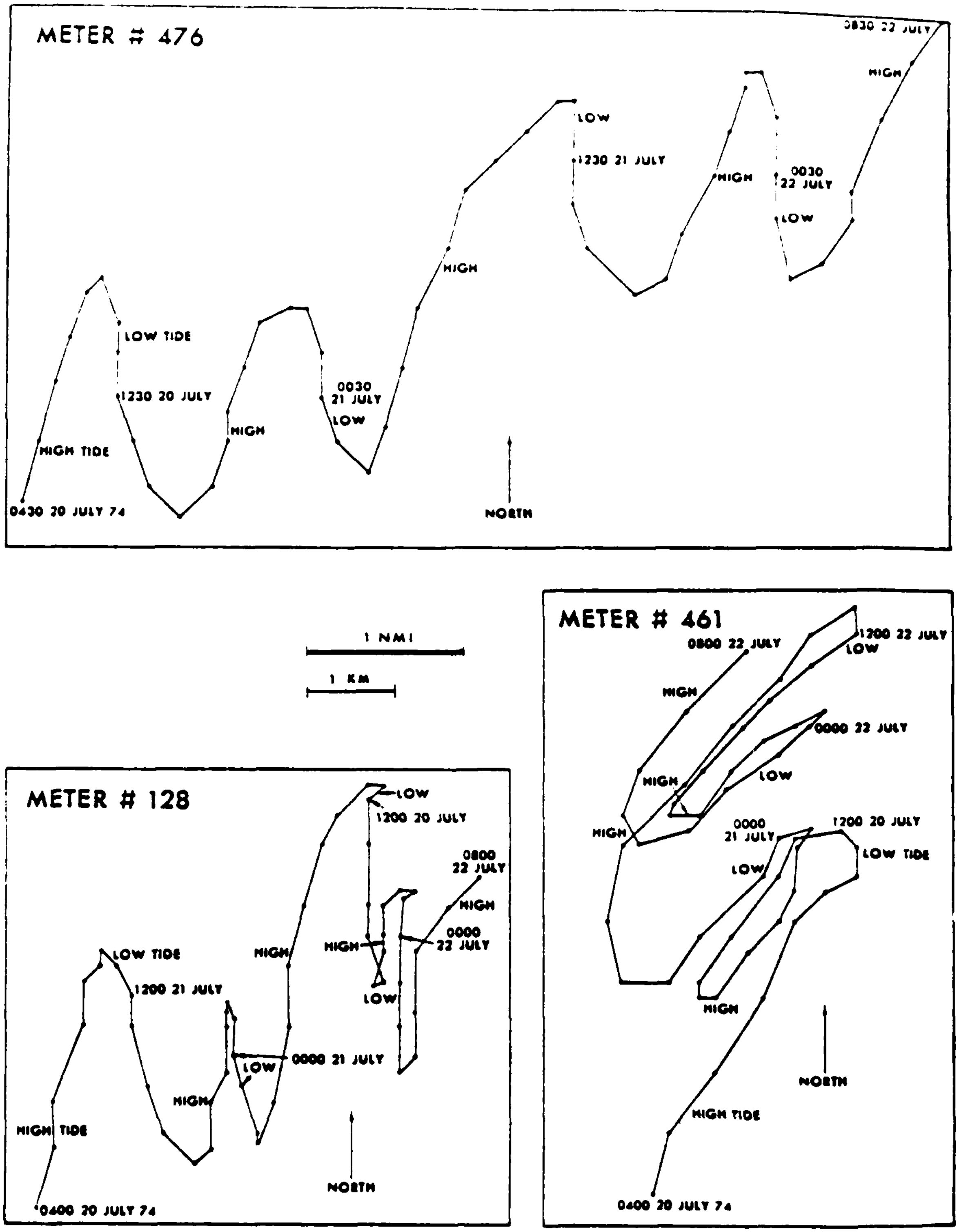


Figure C-16. VectorDiagrams of Tidal Currents (Pathlines of Drogues)

APPENDIX D

PERSONNEL

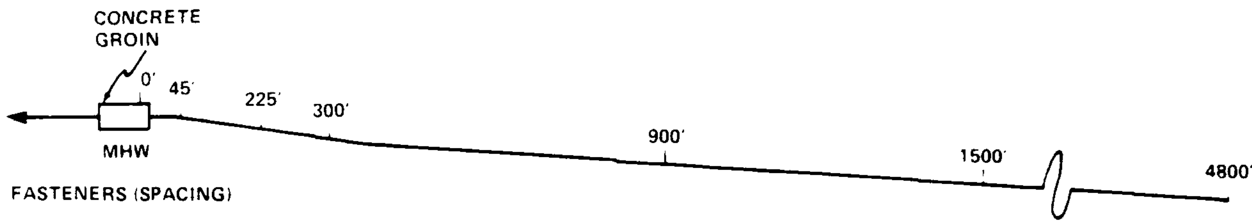
APPENDIX E

BARSTUR UQC REPAIR/REPLACEMENT CABLE STABILIZATION

BARSTUR UQC REPAIR/REPLACEMENT CABLE STABILIZATION

Stabilization Design

Wave force analyses using 15 foot 11.5 second design waves approaching the Barking Sands coastline from the west-southwest and a 1 knot coupled tidal current, indicates the cable stabilization required for a 20 year design life would be prohibitively costly and precludes installation during the summer 1985 weather window. In addition, cable stabilization techniques require use of rock bolts specially designed for use in the coral seafloor at Barking Sands. These rock bolts must remain in tension in order to sustain lateral holding power. The ability of these bolts to retain tension cannot be verified without visual insite observation. As a result, the stabilization shown in Figure E-1 and Table E-1 has been recommended to and approved by PMTC for use in stabilization of the UQC repair/replacement cables. Table E-1 summarizes the material requirements for the cable stabilization.



FASTENERS (SPACING)

SEA END OF GROIN TO 300 FT SPLIT PIPE ON CABLE W/5/8" COMM. ROCK BOLT AND 2-BOLT STEEL CLAMP
300-900 FT 2-BOLT PVC CLAMP (30 FT SPACING)
900-1500 FT 1-BOLT PVC CLAMP (50 FT SPACING)
1500-1800 FT 1-BOLT PVC CLAMP (100 FT SPACING)

Table E-1

BARSTUR UQC REPAIR/REPLACEMENT CABLE STABILIZATION

Material Requirements	**Required Project Total**
Split Pipe (300 ft.) 100 sections/cable	300 sections
5/8-inch rock bolts	200 bolts
2 Bolt Steel Pipe Clamps	50 clamps
2 Bolt PVC Cable Clamps	100 clamps
1 Bolt PVC Cable Clamps	220 clamps

In order to ensure a long life for the cable stabilization, it is recommended that annual or biannual inspection of the cable be performed.

Installation Procedure

The recommended cable stabilization will be installed as follows:

a. When the UQC repair/replacement cables are laid out, the 300 feet of split pipe will be applied as it leaves the deck of the cable barge.

b. When in position on the ocean floor, UCT-2 divers will drill and install split pipe clamps. When rock or coral is encountered under the split pipe, 5/8-inch by 24-inch commercial rock bolts will be used.

APPENDIX F

SPLICING AND CABLE TESTING

(PROCEDURES FOR CABLE SPLICING AND TESTING
WILL BE PROVIDED AT A LATER DATE)

APPENDIX G

BEACH CONSTRUCTION

Beach Construction

Graphic details of the required beach construction effort cannot be provided until bench marks and surveys of the beach are completed. Surveys are to be accomplished beginning the week of 16 May 1985 by UCT-2 personnel detailed to Barking Sands for this purpose.

The beach construction survey will be conducted to determine the following information:

- o Location of the cable termination point.
- o Location and distance from the cable termination point to the concrete groin on the beach. This is required to determine the amount of cable which must be initially pulled off the barge during cable landing before the 300 feet of split pipe is applied.
- o Location of the cut to be made through the berm. This Location must allow for the TD-20 dozer to make a straight pull across the beach from along the cable track.
- o Location of the inshore barge moorings. These positions are to be marked with buoys after a diver survey of the location is made to assure there will be no interference with existing cables.
- o Location and distance to the offshore mooring and to determine the position of the barge at the cable splicing location.
- o Determine the beach profile before beginning construction. This will allow beach restoration to be made preserving existing profiles.

The above information will be used to plan the subsequent beach construction efforts. In addition, it will allow the cable to be marked while it is being loaded onboard the barge and assist in determining the status of the cable lay as it is pulled ashore and being laid along the cable track.

Berm Removal

The berm is located above the high water line at the beach site. Sufficient material will be removed from the berm to bring the beach to grade with the area behind the berm. The berm is estimated to be 10 feet high and 150 feet from toe to toe. A cut to grade of approximately 30 feet wide must be made to allow the dozer hauling in the cable to pass through. An appropriate slope (45° to 60°) along the walls of the cut will be held to prevent the sand from sliding into the cut. All material to be removed will be placed behind and to the north of the cut. Three to four days of work using the TD-20 dozer is estimated to be required for this effort.

Cable Trench

The cable trench will be dug after both hydrophone cables are laid. This will be done using the backhoe. This procedure prevents having to maintain an open trench for a long period of time, thereby reducing a personnel hazard as well as a avoiding the difficulty of loosing the trench as a result of the soft beach material.

The cable trench will run from the shore side of the concrete groin through the berm cut and to the cable termination point.

Beach Restoration

Following completion of the beach construction efforts, the beach, berm, and area between the berm and the cable termination point will be restored to original profiles. In addition, all trash and debris will be removed from the beach area. It is not anticipated that replanting of brush and beach plant growth will be necessary as part of the beach restoration process. All equipment and unused material will be removed and relocated in accordance with guidance provided by PMRF, BARSTUR, Kauai, Hawaii.

END

DTIC

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